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Project T10/BSR INCITS 491

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Information technology - SCSI / ATA Translation - 4 (SAT-4)

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American National Standard
for Information Technology

SCSI / ATA Translation - 4

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ABSTRACT

This standard specifies a translation layer between SCSI and ATA protocols. This translation layer is used by storage controllers to emulate objects in a SCSI logical unit using an ATA device, providing capabilities defined by SCSI standards (e.g., the SCSI Block Commands (SBC-3) and SCSI Primary Commands (SPC-4) standards). For the purposes of this standard, ATA device capabilities are defined by ATA8-AAM, ACS-4, ATA8-APT, ATA8-AST, and SATA-3.3.

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American National Standards for Information Systems -

SCSI / ATA Translation - 4

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American National Standards Institute, Inc.

Abstract

This standard specifies a translation layer between SCSI and ATA protocols. This translation layer is used by storage controllers to emulate objects in a SCSI logical unit using an ATA device, providing capabilities defined by SCSI standards (e.g., the SCSI Block Commands (SBC-4), SCSI Zoned Block Commands (ZBC), and SCSI Primary Commands (SPC-5) standards). For the purposes of this standard, ATA device capabilities are defined by ATA8-AAM, ACS-4, ZAC, ATA8-APT, ATA8-AST-2, and SATA-3.3.

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R.0b SAT-4 r00b (9 February 2015)

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Foreword

This foreword is not part of American National Standard INCITS ***-200x.

This standard provides a common set of definitions and requirements to establish common behavior among implementations that emulate SCSI device behavior through the combined use of ATA devices and a SCSI / ATA Translation layer (SATL). The SATL may reside in a host-based software or firmware, or it may reside in a separate component (e.g., a host bus adapter or external controller) with a separate processing unit to perform the translation. A SATL and ATA device combination may provide a functional subset of common SCSI capabilities. There is also a range of optional emulated SCSI capabilities that may be supported, depending on the capabilities of the SATL.

This standard defines SATL capabilities in terms of SCSI capabilities as defined by the applicable SCSI standards and working drafts, and defines the elements and use of ATA protocol to provide those SCSI capabilities and services in a consistent manner among SAT implementations that implement according to this standard.

With any technical document there may arise questions of interpretation as new products are implemented. INCITS has established procedures to issue technical opinions concerning the standards developed by INCITS. These procedures may result in SCSI Technical Information Bulletins being published by INCITS.

These Bulletins, while reflecting the opinion of the Technical Committee that developed the standard, are intended solely as supplementary information to other users of the standard. This standard, ANSI INCITS 491:201x, as approved through the publication and voting procedures of the American National Standards Institute, is not altered by these bulletins. Any subsequent revision to this standard may or may not reflect the contents of these Technical Information Bulletins.

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Requests for interpretation, suggestions for improvement and addenda, or defect reports are welcome. They should be sent to the INCITS Secretariat, National Committee for Information Technology Standards, Information Technology Institute, 1250 Eye Street, NW, Suite 200, Washington, DC 20005-3922.

This standard was processed and approved for submittal to ANSI by the InterNational Committee for Information Technology Standards (INCITS). Committee approval of the standard does not necessarily imply that all committee members voted for approval.

Technical Committee T10 on SCSI Storage Interfaces, which developed and reviewed this standard, had the following members:

Ralph Weber, Chair
William Martin, Vice-Chair
John Geldman, Secretary

Introduction

The SCSI / ATA Translation - 4 standard is divided into the following clauses:

Clause 1 defines the scope of this standard.

Clause 2 enumerates the normative references that apply to this standard.

Clause 3 describes the definitions, symbols, abbreviations, and notation conventions used in this standard.

Clause 4 describes the general framework for defining elements of translation between SCSI and ATA protocol.

Clause 5 describes elements of SCSI / ATA Translation that relate to the SCSI architecture model.

Clause 6 describes the mapping of command management functions in the SATL layer.

Clause 7 provides a summary of SCSI commands mapped to ATA in this standard.

Clause 8 describes the mapping between SCSI Primary Commands and ATA protocol.

Clause 9 describes the mapping between SCSI Block Commands and ATA protocol.

Clause 10 describes the mapping of mode pages, log pages, and VPD page information to selected ATA protocol elements.

Clause 11 describes error reporting and sense data conventions for SCSI / ATA Translation.

Clause 12 describes SCSI commands and mode pages to support SCSI / ATA Translation.

Annex A describes command translation for ATAPI devices.

American National Standard
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SCSI / ATA Translation - 4 (SAT-4)

1 Scope

The set of SCSI standards specifies the interfaces, functions, and operations necessary to ensure interoperability between conforming SCSI implementations. This standard is a functional description. Conforming implementations may employ any design technique that does not violate interoperability.

This standard defines the protocol requirements of the SCSI / ATA Translation Layer (SATL) to allow conforming SCSI / ATA translating components to interoperate with ATA devices, SCSI transports, and SCSI application layers. The SATL covers a range of implementations that use ATA devices to emulate the behavior of SCSI devices as viewed by the SCSI application layer. The primary focus of this standard is to define SCSI / ATA Translation for an ATA device (see 3.1.9).

Where possible, this standard defines SCSI / ATA Translation in a manner that is consistent with the SAM-5, SPC-5, SBC-4, and ZBC standards. In some instances, the defined function of an ATA device is different from corresponding functions defined for SCSI target devices (e.g., many ATA devices provide no means to abort a single ATA queued command). The translation defined in this standard, in such cases, may not be consistent with other SCSI standards. However, in such cases, this standard specifies the expected behavior, and in what manner it is inconsistent with the behavior specified in other SCSI standards.

The objective of this standard is to allow an interoperable set of SCSI functions while minimizing the complexity of the SATL and preserving compatibility with existing SCSI application clients.

The objectives of the SATL are:

a) to provide host computers with device independence with respect to the ATA devices that have user storage capacity, and with respect to various implementations of the translation layer used to emulate the behavior of SCSI target devices;
b) to define common features and functions representing a subset of the capabilities available in SCSI devices that apply to SCSI / ATA Translation implementations;
c) to define common methods to manage aspects of ATA devices that do not map to previously defined features and functions of SCSI, with provision made for the addition of special features and functions; and
d) to provide consistent means for discovery and control of optional SCSI features that may or may not be emulated in SCSI / ATA translator implementations. These means are provided by specifying how transport specific features and functions are represented in a mixed-domain topology in a manner consistent with management of devices in a SCSI domain.

Figure 1 shows the general structure of SCSI standards. Figure 1 is not intended to imply a relationship such as a hierarchy, protocol stack, or system architecture.

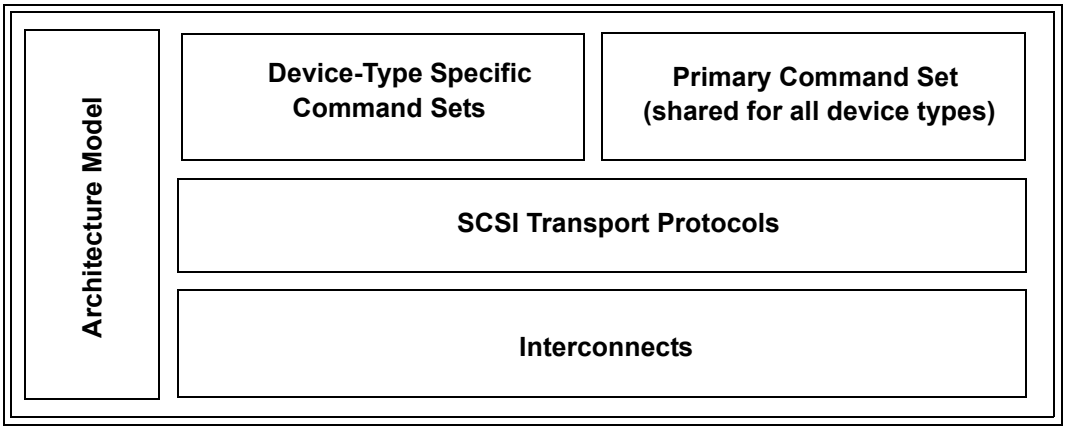


Figure 1 — SCSI document relationships

The term SCSI is used wherever it is not necessary to distinguish between the different SCSI standards.

Figure 2 shows the relationship of the ATA8 documents to each other.

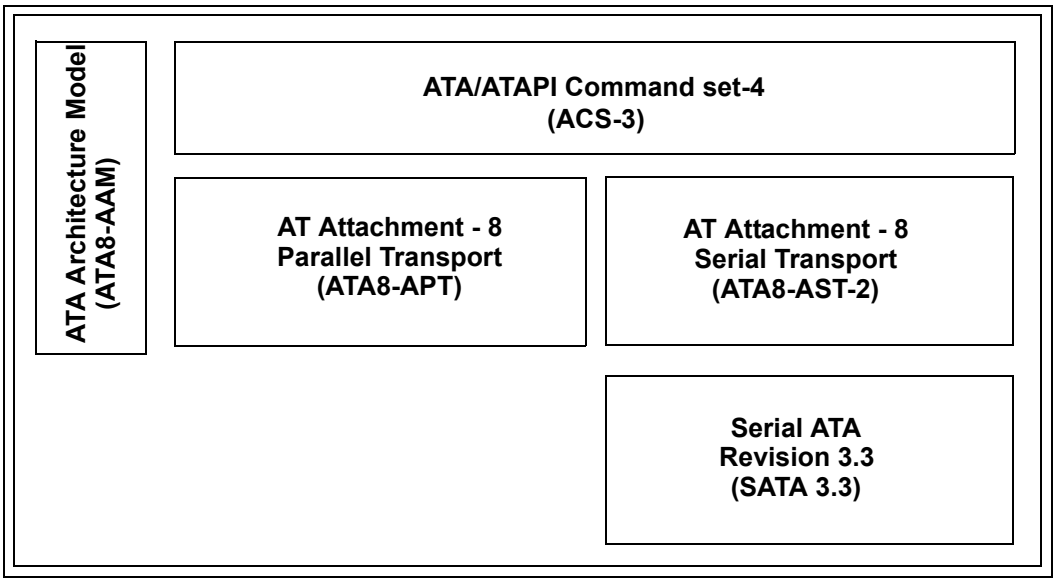


Figure 2 — ATA document structure

Figure 3 shows the relationship of this standard to standards in both the SCSI family of standards and the ATA family of standards.

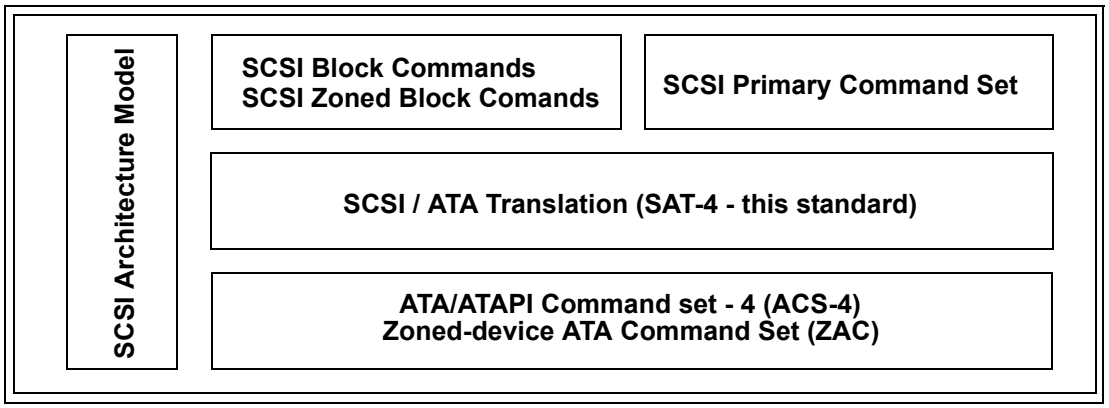


Figure 3 — SCSI / ATA Translation document role

This standard defines a translation between the SCSI application layer (see SAM-5) and ATA device protocol.

2 Normative References

2.1 Normative references overview

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 14776-262, *SAS Protocol Layer-2 (SPL-2)*

T10/BSR INCITS 502, SCSI Primary Commands - 5 (SPC-5) (planned as ISO/IEC 14776-455)

T10/BSR INCITS 513, *SCSI Primary Commands - 4 (SPC-4) (planned as* ISO/IEC 14776-454)

T10/BSR INCITS 515, *SCSI Architecture Model - 5 (SAM-5)* (planned as ISO/IEC 14776-415)

T10/BSR INCITS 518, *SCSI Enclosure Services - 3 (SES-3)* (planned as ISO/IEC 14776-373)

T10/BSR INCITS 536, Block Commands (ZBC) (planned as ISO/IEC 14776-345)

ISO/IEC 14776-861, *AT Attachment-8 Architecture Model (ATA8-AAM)* [ANSI INCITS 451-2008]
ATA/ATAPI Command Set - 2 (ACS-2) [ANSI INCITS 482-2012]
INCITS 452-2009/AM 1-2010 AT Attachment-8 ATA/ATAPI Command Set (ATA8-ACS) Amendment 1
SCSI / ATA Translation - 3(SAT-3) (planned as ISO/IEC 14776-923)

2.2 References under development

At the time of publication, the following referenced standards were still under development. For information on the current status of the document, or regarding availability, contact the relevant standards body or other organization as indicated.

AT Attachment-8 Parallel Transport (ATA8-APT) [ANSI INCITS 524-201x]
ISO/IEC 14776-454, *SCSI Primary Commands - 4 (SPC-4)* [ANSI INCITS 513-201x]
ISO/IEC 14776-323, *SCSI Block Commands - 3 (SBC-3)* [ANSI INCITS 514-201x]
ISO/IEC 14776-201*, Serial Attached SCSI - 3 (SAS-3)* [ANSI INCITS 519-201x]
ISO.IEC 14776-154, *SCSI Architecture Model - 5 (SAM-5)* [ANSI INCITS 515-201x]
ISO/IEC-14776-263, *SAS Protocol Layer - 3 (SPL-3)* [ANSI INCITS 492-201x]
ATA/ATAPI Command Set - 3 (ACS-3) [ANSI INCITS 522-201x]

2.3 Other references

For information on the current status of the listed document(s), or regarding availability, contact the indicated organization.

Serial ATA Revision 3.2 (SATA-3.2)

The SATA 3.2 document may be obtained from Serial ATA International Organization (SATA-IO) at http://www.sata-io.org.

Mass Storage Class Bulk-Only Transport 1.0 (USB-BOT)

The USB-BOT document may be obtained from the USB Implementors Forum, Inc. at http://www.usb.org.

3 Definitions, symbols, abbreviations, and conventions

3.1 Definitions

3.1.1 additional sense code: A combination of the ADDITIONAL SENSE CODE field and the ADDITIONAL SENSE CODE QUALIFIER field in the sense data (see SPC-4)

3.1.2 Advanced Power Management (APM): The Advanced Power Management feature set as defined in ACS-3

3.1.3 allocation length: value in the ALLOCATION LENGTH field of a CDB that specifies the maximum number of bytes that an application client has allocated in the Data-In Buffer and that is used to limit the maximum amount of variable length data (e.g., mode data, log data, diagnostic data) returned to an application client (see SPC-4)

3.1.4 application client: object that is the source of SCSI commands (see SAM-5)

3.1.5 AT Attachment (ATA): family of standards and specifications that define the attachment of storage devices to hosts (see ATA8-AAM, ACS-3, ATA8-APT, and SATA-3.1)

3.1.6 AT Attachment Packet Interface (ATAPI): PACKET Command feature set, as defined in ACS-3, that provides the capability to encapsulate SCSI and other types of commands and pass them over an ATA transport

3.1.7 ATA abort retry: policy implemented by a SATL whereby the SATL retries ATA commands aborted by ATA collateral abort (see clause 3.1.8) once

3.1.8 ATA collateral abort: ATA command that is aborted as a result of a different command being aborted when an ATA device is processing queued commands (i.e., NCQ)

3.1.9 ATA device: device that complies with ATA standards and implements the General feature set (see ATA8-AAM and ACS-3)

3.1.10 ATA device capacity: ATA logical sector size, (see clause 3.1.19) times one more than the ATA maximum LBA (see clause 3.1.20)

3.1.11 ATA domain: I/O subsystem that is made up of one ATA host, a service delivery subsystem, and one or more ATA devices or ATAPI devices (see ATA8-AAM)

3.1.12 ATA download microcode command: DOWNLOAD MICROCODE command or DOWNLOAD MICROCODE DMA command (see ACS-3)

3.1.13 ATA flush command: FLUSH CACHE command or FLUSH CACHE EXT command (see ACS-3)

3.1.14 ATA hardware reset: routines performed by the ATA device server and the ATA device port in an ATA device after a hardware reset event occurs (see ATA8-AAM)

3.1.15 ATA host: object that originates requests to be processed by an ATA device or an ATAPI device

3.1.16 ATA host aware zoned device: ATA device supporting the Host Aware Zones feature set (i.e., sets the ZONED field to 01b in the Supported Capabilities page of the IDENTIFY DEVICE data log

Note 1 to entry: see ACS-4.

3.1.17 ATA host managed zoned device:: ATA device presenting the signature of a host managed device and supporting the Host Managed Zones feature set

Note 1 to entry: see ACS-4.

3.1.18 ATA LBA: LBA (see 3.1.56) used to reference a logical sector in an ATA device (see ACS-3)

3.1.19 ATA logical sector size: size of an ATA logical sector in bytes (see clause 5.8)

3.1.20 ATA maximum LBA: maximum user LBA for the ATA device (see 5.7)

3.1.21 ATA NCQ command: ATA READ FPDMA QUEUED command, WRITE FPDMA QUEUED command, RECEIVE FPDMA QUEUED command, SEND FPDMA QUEUED command, or FPDMA NON-DATA command.(see ACS-3)

3.1.22 ATA nexus loss event: transport-specific event where an ATA host port is no longer in communication with an ATA device port (see ATA8-AAM, see 5.5)

3.1.23 ATA non-NCQ command: ATA command that is not an ATA NCQ command (see 3.1.21)

3.1.24 ATA non-queued command: ATA command that is not an ATA queued command (see 3.1.25)

3.1.25 ATA queued command: ATA NCQ command

3.1.26 ATA QWord: sequence of eight contiguous bytes or eight contiguous characters considered as a unit as described in ACS-3

3.1.27 ATA read command: READ DMA command, READ DMA EXT command, READ MULTIPLE command, READ MULTIPLE EXT command, READ SECTOR(S) command, READ SECTOR(S) EXT command, or READ FPDMA QUEUED command as selected by Table 47(see ACS-3)

3.1.28 ATA read log command: SMART READ LOG command, READ LOG EXT command or READ LOG DMA EXT command (see ACS-3)

3.1.29 ATA Sector Count: count of ATA logical sectors to transfer or process, represented by the SECTOR COUNT (for non-NCQ commands) or FEATURE (for NCQ commands) field in an ATA command (see ACS-3)

3.1.30 ATA software reset: reset that is triggered by an ATA task management function request (see ATA8-AAM, see also 5.6)

3.1.31 ATA trusted receive command: TRUSTED RECEIVE command or TRUSTED RECEIVE DMA command (see ACS-3)

3.1.32 ATA trusted send command: TRUSTED SEND command or TRUSTED SEND DMA command (see ACS-3)

3.1.33 ATA verify command: READ VERIFY SECTOR(S) command or ATA READ VERIFY SECTOR(S) EXT command (see ACS-3)

3.1.34 ATA volatile settings: ATA device settings affecting the way an ATA device responds to ATA commands that are configurable using ATA commands (e.g., ATA SET FEATURES command or ATA SET MAX EXT command), that do not persist across resetting events, and that are set by the SATL to correspond to SCSI mode parameters, log parameters, or INQUIRY data

3.1.35 ATA write command: WRITE DMA command, WRITE DMA EXT command, WRITE DMA FUA EXT command, WRITE MULTIPLE command, WRITE MULTIPLE EXT command, WRITE MULTIPLE FUA EXT command, WRITE SECTOR(s) command, WRITE SECTOR(s) EXT command, or WRITE FPDMA QUEUED command, as selected by Table 47 (see ACS-3)

3.1.36 ATA write log command: SMART WRITE LOG command, WRITE LOG EXT command, or WRITE LOG DMA EXT command (see ACS-3)

3.1.37 ATAPI device: device that is compliant with the ATA standards and implements the PACKET feature set (see ACS-3)

3.1.38 auto-contingent allegiance (ACA): task set condition established following the return of a CHECK CONDITION status when the NACA bit is set to one in the CONTROL byte (see SAM-5)

3.1.39 autosense: sense data that is returned in the same I_T_L_Q nexus transaction as the CHECK CONDITION status (See SAM-5) The alternative to autosense (i.e., use of a REQUEST SENSE command) is defined in SAM-2

NOTE 1 - SAM-5 specifies what SAM-2 defines as autosense as the only valid way of returning SENSE data, but does not refer to it as autosense

3.1.40 byte: sequence of eight contiguous bits considered as a unit

3.1.41 command: request describing a unit of work to be performed by a device server (see SAM-5)

3.1.42 command descriptor block (CDB): structure used to communicate a command from a SCSI application client to a SCSI device server

3.1.43 device server: object within the logical unit that processes SCSI commands according to the rules for command management (see SAM-5)

3.1.44 direct logical block mapping: SATL implementation that maps logical blocks on a logical unit one-for-one with ATA logical sectors on an ATA device, where the LBA of a logical block has the same value as the LBA of the corresponding ATA logical sector and the number of bytes in a logical block equals the number of bytes in an ATA logical sector (see 9.1.2)

3.1.45 domain: SCSI domain (see SAM-5) or an ATA domain (see ATA8-AAM)

3.1.46 DRQ data block: unit of data words associated with available status when using either the PIO data-in command protocol or the PIO data-out command protocol (see ACS-3)

3.1.47 dword: sequence of four contiguous bytes considered as a unit

3.1.48 field: group of one or more contiguous bits

3.1.49 indirect logical block mapping: SATL implementation that does not follow the constraints of direct logical block mapping (see 3.1.44 and 9.1.3)

3.1.50 I_T nexus: nexus between a SCSI initiator port and a SCSI target port (see SAM-5)

3.1.51 I_T_L nexus: nexus between a SCSI initiator port, a SCSI target port, and a logical unit (see SAM-5)

3.1.52 I_T_L_Q nexus: nexus between a SCSI initiator port, a SCSI target port, a logical unit, and a command (see SAM-5)

3.1.53 least significant bit (LSB): In a binary code, the bit or bit position with the smallest numerical weighting in a group of bits that, when taken as a whole, represent a numerical value (e.g., in the number 0001b, the bit that is set to one)

3.1.54 link reset sequence: phy reset sequence (see SATA-3.1)

3.1.55 logical block: set of data bytes accessed and referenced as a unit (see SBC-3)

3.1.56 logical block address (LBA): value used to reference a logical block

3.1.57 logical unit: externally addressable entity within a SCSI target device (see SAM-5)

3.1.58 logical unit capacity: capacity of a logical unit in bytes calculated as length in bytes of each logical block times one more than the LBA of the last logical block on the logical unit

3.1.59 logical unit number (LUN): identifier for a logical unit (see SAM-5)

3.1.60 logical unit reset event: event that triggers a logical unit reset (see SAM-5)

3.1.61 logical unit reset: condition resulting from a hard reset condition or a logical unit reset event in which the logical unit performs the logical unit reset operations described in SAM-5, SPC-4, and this standard

3.1.62 medium: material on which data is stored (e.g., a magnetic disk)

3.1.63 most significant bit (MSB): Ibit or bit position in a binary code with the largest numerical weighting in a group of bits that, when taken as a whole, represent a numerical value (e.g., in the number 1000b, the bit that is set to one)

3.1.64 native command queuing (NCQ): method by which a SATA device that does not implement the PACKET Command feature set may maintain and order the processing of up to 32 outstanding commands (see ACS-3)

3.1.65 nexus: relationship between a SCSI initiator port and a SCSI target port that may extend to a logical unit and a command (see SAM-5)

3.1.66 object: architectural abstraction or container that encapsulates data types, services, or other objects that are related in some way

3.1.67 Parallel ATA (PATA): parallel transport protocol (see ATA8-APT)

3.1.68 PATA bus: the conductors and connectors required to attain signal line continuity between every driver, receiver, and terminator for each signal between one PATA host and one or two PATA devices (see ATA8-APT)

3.1.69 PATA device: ATA device or ATAPI device that uses the PATA transport protocol (see ATA8-APT)

3.1.70 PATA host: An ATA host that uses the PATA transport protocol (see ATA8-APT)

3.1.71 power on: Power being applied

3.1.72 queued command: ATA queued command (see 3.1.25), or a SCSI command received by the SATL from an application client for an emulated logical unit while the emulated logical unit is processing another SCSI command (see SAM-5)

3.1.73 reset event: transport protocol specific event that results in a hard reset condition (see SAM-5) or a hardware reset (see ATA8-AAM)

3.1.74 SAS address: identifier assigned to a SAS port or expander device (see SAS-3)

3.1.75 SAS initiator device: device containing SSP initiator ports, STP initiator ports, and/or SMP initiator ports in a SAS domain (see SAS-3)

3.1.76 SAS initiator port: SSP initiator port, STP initiator port, and/or SMP initiator port in a SAS domain (see SAS-3)

3.1.77 SATA device: ATA device or ATAPI device that uses the Serial ATA transport protocol (see SATA-3.1)

3.1.78 SATA host: ATA host that implements the Serial ATA transport protocol (see SATA-3.1)

3.1.79 SCSI / ATA Translation Layer (SATL): functional layer defined in this standard that uses an ATA device to emulate objects in a SCSI logical unit, including the device server, task manager, and task set (see SAM-5)

3.1.80 SCSI device: device that contains one or more SCSI ports that are connected to a service delivery subsystem and supports a SCSI application protocol

3.1.81 SCSI hard reset: condition resulting from a power on condition or a reset event in which the SCSI device performs the hard reset operations described in SAM-5, SPC-4, and the appropriate command and transport standards

3.1.82 SCSI initiator port: SCSI initiator device object that acts as the connection between application clients and a service delivery subsystem through which requests and responses are routed (see SAM-5)

3.1.83 SCSI READ command: READ(10), READ(12), or READ(16) command (see SBC-3)

3.1.84 SCSI SYNCHRONIZE CACHE command: SYNCHRONIZE CACHE(10) or SYNCHRONIZE CACHE (16) command (see SBC-3)

3.1.85 SCSI target port: SCSI target device object that contains a task router and acts as the connection between device servers, task managers, and a service delivery subsystem through which requests and responses are routed (see SAM-5)

3.1.86 SCSI VERIFY command: VERIFY (10), VERIFY (12), or VERIFY (16) command (see SBC-3)

3.1.87 SCSI WRITE command: WRITE (10), WRITE (12), or WRITE (16) command (see SBC-3)

3.1.88 SCSI WRITE AND VERIFY command: WRITE AND VERIFY (10), WRITE AND VERIFY (12), or WRITE AND VERIFY (16) command (see SBC-3)

3.1.89 Serial ATA (SATA): serial transport protocol that serves as an ATA service delivery subsystem (see SATA-3.1)

3.1.90 Serial ATA Tunneled Protocol (STP): protocol used by STP initiator ports to communicate with STP target ports in a SAS domain (see SAS-3)

3.1.91 Serial Attached SCSI (SAS): set of protocols and the interconnect defined by SAS-3

3.1.92 service delivery subsystem: That part of a SCSI I/O system that transmits service requests to a logical unit or SCSI target device and returns logical unit or SCSI target device responses to a SCSI initiator device (see SAM-5) or that part of an ATA I/O system that connects an ATA host port and one or more ATA/ATAPI device ports and is a single path for the transfer of requests and responses between a host and one or more devices (see ATA8-AAM)

3.1.93 service response: device service response or SCSI transport protocol specific service response returned to an application client by the SATL on completion of a SCSI transport protocol service request (see SAM-5)

3.1.94 STP initiator port: SAS initiator device object in a SAS domain that interfaces to a service delivery subsystem with STP (see SAS-3)

3.1.95 STP target port: SAS target device object in a SAS domain that interfaces to a service delivery subsystem with STP (see SAS-3)

3.1.96 STP/SATA bridge: expander device object containing an STP target port, a SATA host port, and the functions required to forward information between the STP target port and SATA host port to enable STP initiator ports in a SAS domain to communicate with SATA devices in an ATA domain (see SAS-3)

3.1.97 task management function: task manager service capable of being requested by an application client to affect the processing of one or more commands (see SAM-5)

3.1.98 task set: group of commands within a device server whose interaction is dependent on the task management and ACA rules (see SAM-5)

3.1.99 Transport Protocol-Specific Information Unit (TPSIU): transport-specific information unit used to transport information between initiator ports and target ports that may contain additional information needed by a service delivery subsystem to effect the requested information unit transfers (e.g., the Command Block Wrapper defined in USB-BOT)

3.1.100 word: sequence of two contiguous bytes considered as a unit.

3.2 Symbols and abbreviations

≠ or NE	not equal
≤ or LE	less than or equal to
±	plus or minus
≈	approximately
x	multiply
+	add
-	subtract
< or LT	less than
= or EQ	equal
> or GT	greater than
≥ or GE	greater than or equal to
ABRT	Abort bit in the ATA Error field (see ACS-3)
ACA	auto-contingent allegiance (see 3.1.38)
APM	Advanced Power Management (see clause 3.1.2)
ATA	AT Attachment (see 3.1.5)
ATAPI	AT Attachment Packet Interface (see 3.1.5)
CDB	command descriptor block (see 3.1.42)
CRC	Interface CRC bit in the ATA Error field (see ACS-3)
DF	Device Fault bit in the ATA Status field (see ACS-3)
ERR	Error bit in the ATA Status field (see ACS-3)
FIS	Frame Information Structure (see SATA-3.1)
h	Hours
IDNF	ID Not Found bit in the ATA Error field (see ACS-3)
LBA	logical block address (see 3.1.56)
LSB	least significant bit (see 3.1.53)
LUN	logical unit number (see 3.1.59)
min	Minutes
MSB	most significant bit (see 3.1.63)
n/a	not applicable
NCQ	Native Command Queuing (see 3.1.64)
PATA	Parallel ATA (see 3.1.67)
s	Seconds
SAS	Serial Attached SCSI (see 3.1.91)(see also SPL-2)
SAT	SCSI / ATA Translation
SATA	Serial ATA (see 3.1.89)
SATA 3.1	Serial ATA revision 3.1 specification (see 2.3)
SATL	SCSI / ATA Translation Layer (see 3.1.79)
SAM-2	SCSI Architecture Model-2 standard (see)
SAM-5	SCSI Architecture Model-5 standard (see)
SBC-3	SCSI Block Commands-3 standard (see)

SCSI Small Computer System Interface family of standards
SCT Smart Command Transport (see ACS-3)
SPC-4 SCSI Primary Commands-4 standard (see)
STP Serial ATA Tunneled Protocol (see 3.1.90)
TPSIU Transport Protocol-Specific Information Unit (see 3.1.99)
UNC Uncorrectable Error bit in the ATA Error field (see ACS-3)
VPD vital product data (see SPC-4)

3.3 Keywords

3.3.1 invalid: keyword used to describe an illegal or unsupported bit, byte, word, field or code value. Receipt of an invalid bit, byte, word, field or code value shall be reported as an error.

3.3.2 mandatory: keyword indicating an item that is required to be implemented as defined in this standard.

3.3.3 may: keyword that indicates flexibility of choice with no implied preference; equivalent to may or may not

3.3.4 may not: keywords that indicates flexibility of choice with no implied preference; equivalent to may or may not

3.3.5 obsolete: keyword indicating that an item was defined in a previous version of a standard but has been removed from the most recent version of that standard.

3.3.6 optional: keyword that describes features that are not required to be implemented by this standard. However, if any optional feature defined by this standards is implemented, then it shall be implemented as defined in this standard.

3.3.7 reserved: keyword referring to bits, bytes, words, fields and code values that are set aside for future standardization. Their use and interpretation may be specified by future extensions to this or other standards. A reserved bit, byte, word or field shall be set to zero, or in accordance with a future extension to this standard. Recipients are not required to check reserved bits, bytes, words or fields for zero values. Receipt of reserved code values in defined fields shall be reported as an error.

3.3.8 shall: keyword indicating a mandatory requirement; equivalent to “is required”.. Designers are required to implement all such requirements to ensure interoperability with other products that conform to this standard.

3.3.9 should: keyword indicating flexibility of choice with a preferred alternative; equivalent to “it is strongly recommended”.

3.3.10 vendor specific: keyword indicating specification of the referenced item is determined by the SCSI device vendor.

3.4 SAT specific terminology

3.4.1 emulated: term designating that the SATL is required to implement functions in addition to or in place of functions supported by an ATA device to provide a defined SCSI capability.

3.4.2 unspecified: term designating that this version of this standard does not specify a translation for a SCSI field. A translation for an unspecified field may be specified by future versions of this standard. Translation of fields marked unspecified shall not conflict with other standards in the set of SCSI standards.

3.5 Conventions

3.5.1 Overview

Certain words and terms used in this standard have a specific meaning beyond the normal English meaning. These words and terms are defined either in 3.1 or in the text where they first appear. Names of commands, statuses, sense keys, and additional sense codes are in all uppercase (e.g., REQUEST SENSE). Lowercase is used for words having the normal English meaning.

If there is more than one CDB length for a particular command (e.g., MODE SENSE (6) and MODE SENSE (10)) and the name of the command is used in a sentence without any CDB length descriptor (e.g., MODE SENSE), then the condition specified in the sentence applies to all CDB lengths for that command.

The names of fields are in small uppercase (e.g., ALLOCATION LENGTH). If a field name is a concatenation of acronyms, uppercase letters may be used for readability (e.g., NORMACA). Normal case is used when the contents of a field are being discussed. Fields containing only one bit are usually referred to as the NAME bit instead of the NAME field.

If a conflict arises between text, tables, or figures, the order of precedence to resolve the conflicts is text; then tables; and finally figures. Not all tables or figures are fully described in the text. Tables show data format and values. Notes do not constitute any requirements for implementors.

3.5.2 Numeric conventions

A binary number is represented in this standard by any sequence of digits consisting of only the Western-Arabic numerals 0 and 1 immediately followed by a lower-case b (e.g., 0101b). Underscores or spaces may be included in binary number representations to increase readability or delineate field boundaries (e.g., 0 0101 1010b or 0_0101_1010b).

A hexadecimal number is represented in this standard by any sequence of digits consisting of only the Western-Arabic numerals 0 through 9 and/or the upper-case English letters A through F immediately followed by a lower-case h (e.g., FA23h). Underscores or spaces may be included in hexadecimal number representations to increase readability or delineate field boundaries (e.g., B FD8C FA23h or B_FD8C_FA23h).

A decimal number is represented in this standard by any sequence of digits consisting of only the Western-Arabic numerals 0 through 9 not immediately followed by a lower-case b or lower-case h (e.g., 25).

When the value of the bit or field is not relevant, x or xx appears in place of a specific value.

This standard uses the following convention for representing decimal numbers:

a) the decimal separator (i.e., separating the integer and fractional portions of the number) is a period;
b) the thousands separator (i.e., separating groups of three digits in the portion of a number) is a space; and
c) the thousands separator is used in both the integer and fractional portion of a number.

Table 1 shows some examples of decimal numbers using various conventions.

Table 1 — Numbering Conventions

French	English	This Standard
0,6	0.6	0.6
3,141 592 65	3.14159265	3.141 592 65
1 000	1,000	1 000
1 323 462,95	1,323,462.95	1 323 462.95

Lists sequenced by letters (e.g., a-red, b-blue, c-green) show no ordering relationship between the listed items. Numbered lists (e.g., 1-red, 2-blue, 3-green) show an ordering relationship between the listed items.

3.5.3 Bit and byte ordering

In this standard, data structures may be defined by a table. A table defines a complete ordering of elements (i.e., bits, bytes, fields, and dwords) within the structure. The ordering of elements within a table does not in itself constrain the order of storage or transmission of the data structure, but in combination with other normative text in this standard, may constrain the order of storage or transmission of the structure.

In a table, any element that is presented in a row above another element in a lower row is more significant than the lower element, and any element presented to the left of another element in the same row is more significant than the element to the right.

If a table shows bit numbering (see table 2), then the least significant bit (LSB) is numbered 0 and each more significant bit has the next greater number than the immediately less significant bit. If a table shows numbering of bytes or characters (see table 3), then the most significant byte or character is represented at the lowest number and each less significant byte or character has the next greater number than the immediately more significant byte.

In a field in a table consisting of more than one bit that contains a single value (e.g., a number), the least significant bit (LSB) is shown on the right and the most significant bit (MSB) is shown on the left (e.g., in a byte, bit 7 is the MSB and is shown on the left, bit 0 is the LSB and is shown on the right). The MSB and LSB are not labeled if the field consists of eight or fewer bits. The MSB and LSB are labeled if the field consists of more than eight bits and has no internal structure defined.

In a field in a table consisting of more than one byte that contains multiple fields each with their own values (e.g., a descriptor), there is no MSB and LSB of the field itself and thus there are no MSB and LSB labels. Each individual field has an MSB and LSB, but they are not labeled.

In a field containing a text string (e.g., ASCII or UTF-8), only the MSB of the first character and the LSB of the last character are labeled.

Multiple byte fields are represented with only two rows, with the non-sequentially increasing byte number denoting the presence of additional bytes.

A dword consists of 32 bits. Table 2 shows a dword containing a single value, where the MSB is on the upper left

in bit 31 and the LSB is on the lower right in bit 0.

Table 2 — Example of ordering of bits and bytes within a multi-byte element

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB) Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24
1	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
2	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
3	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)

Table 3 shows a dword containing four one-byte fields, where byte 0 (the first byte) is on the left and byte 3 (the fourth byte) is on the right. Each byte has an MSB on the left and an LSB on the right.

Table 3 — Example of ordering of bits and bytes within a multiple element

Bit Byte	7	6	5	4	3	2	1	0
0	First byte							
	Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)
1	Second byte							
	Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)
2	Third byte							
	Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)
3	Fourth byte							
	Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)

3.5.4 Notation for byte encoded character strings

When this standard requires one or more bytes to contain specific encoded character, the specific characters are enclosed in single quotation marks. The single quotation marks identify the start and end of the characters that are required to be encoded but are not themselves to be encoded. The characters that are to be encoded are shown in exactly the case that is to be encoded.

An ASCII space character (i.e., 20h) may be represented in a string by the character '¬' (e.g., 'SCSI¬device').

The encoded characters and the single quotation marks that enclose them are preceded by text that specifies the character encoding methodology and the number of characters required to be encoded.

EXAMPLE - Using the notation described in this subclause, stating that eleven ASCII characters 'SCSI¬device' are to be encoded would be the same as writing out the following sequence of byte values: 53h 43h 53h 49h 20h 64h 65h 76h 69h 63h 65h.

3.5.5 Notation for command descriptions

The description of each command begins with a subclause describing the general method applied in translating the SCSI command to the corresponding ATA command(s), as well as any constraints and special considerations that may apply to the translation applied.

The subclause describing the general translation method for each command contains a table formatted like table 4 with two columns as follows:

a) the first column lists each of the fields in the SCSI CDB (see SPC-4 and SBC-3); and
b) the second column is either a brief description of the corresponding ATA features and functions used to implement the identified SCSI field, or a reference to a subsequent subclause containing a more lengthy description of the method of emulation or implementation.

Table 4 — Format for translated command field descriptions

Field	Description or reference
IMPLEMENTED OR EMULATED FIELD	A brief identification of the corresponding ATA features and functions, or a paragraph reference if there are special considerations that need to be applied in the use of the corresponding ATA features and functions that require a separate paragraph of description.
SUMMARY EMULATED FIELD	Summary field with more detailed structure.
UNSPECIFIED FIELD	Unspecified (see 3.4.2)

Tables listing fields in mode pages have an additional column that defines whether the field is changeable or not.

3.5.6 Use of field names defined in ATA standards and specifications

This standard discusses fields and values defined in other standards and specifications, in particular the ATA8-APT standard, the ATA8-ACS standard, the ACS-3 standard, and the ATA8-AAM standard developed by T13, and the SATA-3.1 specification. Such fields and values discussed in this standard are shown using the same notation conventions used in the standards where those fields and values are defined.

When this standard uses terms defined in ATA standards or the SATA-3.1 specification, the following conventions apply:

c) The names of abbreviations, commands, and acronyms used as signal names are in all uppercase (e.g., IDENTIFY DEVICE). Fields containing only one bit are usually referred to as the “name” bit instead of the “name” field;
d) Names of device registers, fields in data structures, and other defined terms are in small upper-case letters (e.g., FEATURES field);
e) The expression “word n” or “bit n” shall be interpreted as indicating the content of word n or bit n;
f) Bit names are shown in all uppercase letters; and
g) Bits n:m denotes a set of bits, for example, bits 7:0.

3.5.7 Flowcharts

This standard uses flowcharts that ISO 5807:1995 (R2003) defines as program flowcharts. Figure 4 shows an example flowchart.

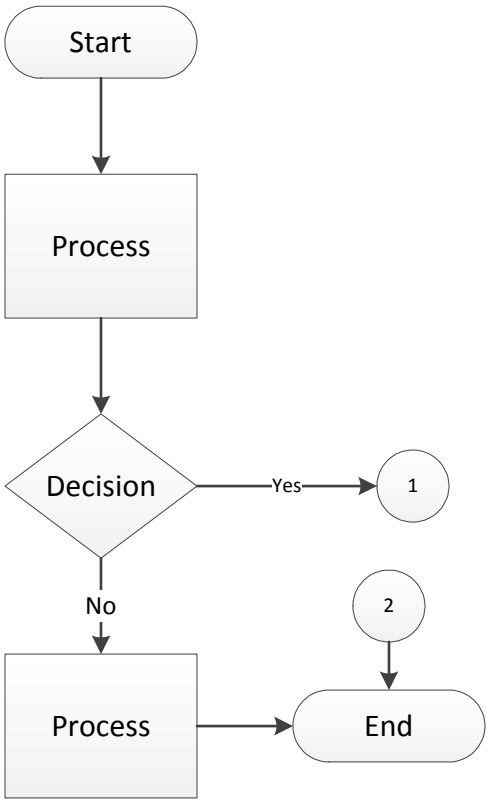


Figure 4 — Example flowchart

The following types of symbols are shown in figure 4:

a) a termination (e.g., start and end) symbol;
b) a process symbol;
c) a decision symbol; and
d) a reference (e.g., 1 and 2) symbol.

A termination symbol shows the starting point for the flowchart or the ending point for the flowchart.

A process symbol shows any kind of processing function that occurs as a result of entering this condition from a previous symbol.

A decision symbol shows a point in the progression of the flowchart from which there is more than one exit possibility of which only one is satisfied by the condition described within the decision symbol.

A reference symbol shows a connection to or from another flowchart that have the same numbers in both the source flowchart and destination flowchart.

4 General

This standard defines a SCSI/ATA translation layer (i.e., the SATL) that provides a method for a SCSI application layer (see SAM-5) to access SATA devices or PATA devices by representing ATA or ATAPI devices as SCSI peripheral devices.

Implementations of SCSI / ATA Translation may provide varying levels of SCSI functionality.

EXAMPLE 1 - The SATL may provide a level of SCSI emulation that is indistinguishable from native SCSI devices in terms of reported capabilities. Such SATL implementations need little guidance from this standard to effect interoperability since other SCSI protocol standards define all that is required to establish interoperability.

EXAMPLE 2 - The SATL may implement a subset of SCSI, have limited or no capability to maintain persistent information about the characteristics or state of the emulated SCSI device, have limited capability to manage device state information that carries forward from one command to the next, and maintain little or no capability to coordinate between multiple commands outstanding at a time. The characteristics and behavior of the underlying ATA devices in these minimal implementations of the SATL are expected to be more visible to the SCSI application clients.

This standard provides a set of definitions, conventions, and guidelines for:

a) the consistent reporting by the SATL of capabilities of emulated SCSI devices,
b) the consistent observed behavior for SCSI operations, and
c) the consistent identification of the attached devices by the application clients.

These provisions allow application clients to observe consistent behavior whether or not the application clients recognize the presence of a SATL in a system.

By defining expected behavior in terms of the SCSI commands received, corresponding activity in the ATA domain, and expected SCSI responses based on the results of activity in the ATA domain, this standard eliminates:

a) incompatibility between legacy SCSI / ATA Translation implementations; and
b) SCSI application client / ATA or ATAPI device interdependence.

This standard refers to behaviors for SCSI devices defined in SBC-3 and SPC-4. Unless otherwise specified, any behaviors that are optional in SBC-3 or SPC-4 are optional for devices implementing SCSI / ATA Translation.

If the SATL receives a SCSI request specifying any value in any field of the CDB that the SATL does not support, unless otherwise specified in the description of the command, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB (see SPC-4).

If the SATL receives a SCSI request specifying any value in any field of the parameter data that the SATL does not support, unless otherwise specified in the description of the parameter, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST (see SPC-4).

5 SCSI architecture

5.1 Overview

This clause defines SCSI / ATA translation of features and functions that impact the representation of the domains defined in SAM-5 and ATA8-AAM. Figure 5 shows a SATL providing a communication path between a SCSI application client and an ATA device or ATAPI device.

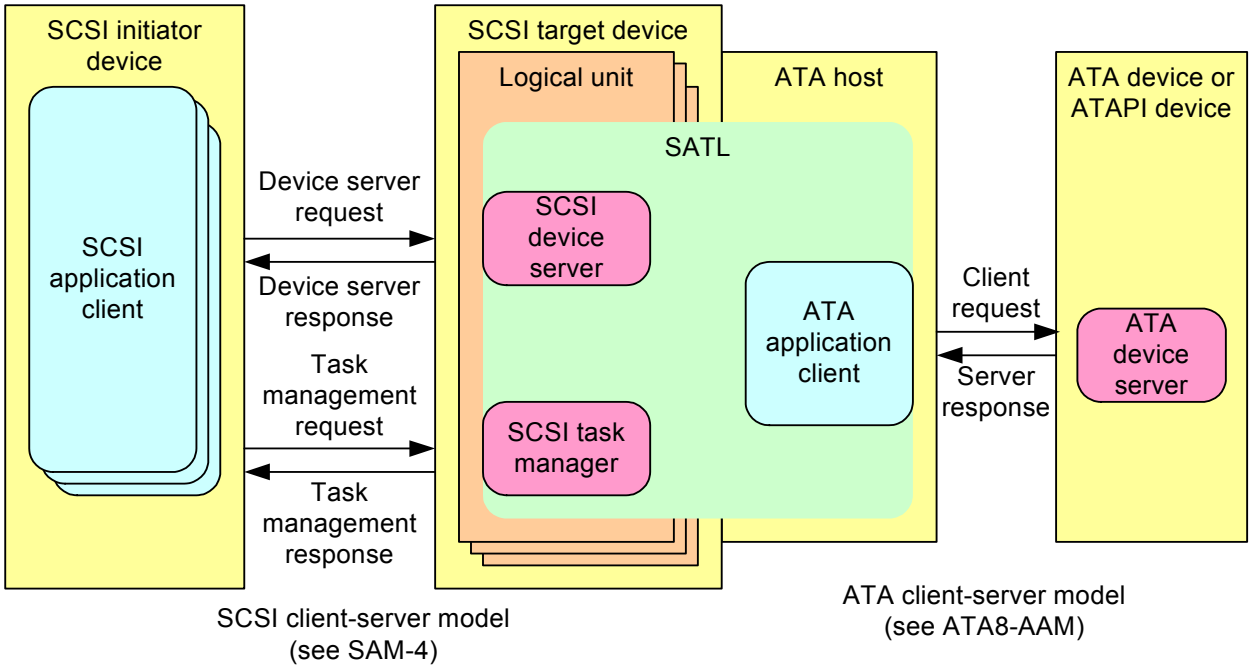


Figure 5 — Example of a SATL between a SCSI application client and an ATA or ATAPI device

The SATL provides the communication path between a SCSI application client and an ATA device or ATAPI device by:

a) emulating a SCSI logical unit;
b) integrating an ATA host; and
c) providing the translation that links them together.

This standard defines SCSI / ATA translation using SCSI and ATA command sets. This standard does not define the mapping of transport capabilities as defined at the SCSI transport protocol layer and the ATA protocol interconnect layer.

An implementation utilizing a SATL may include a SCSI transport. A SATL may appear in different configurations:

EXAMPLE 1 - Figure 6 shows a SATL contained within a SCSI to ATA protocol bridge, where the ATA or ATAPI device is being accessed by an ATA host port, and the SATL is being accessed with a SCSI target port using a SCSI transport protocol.

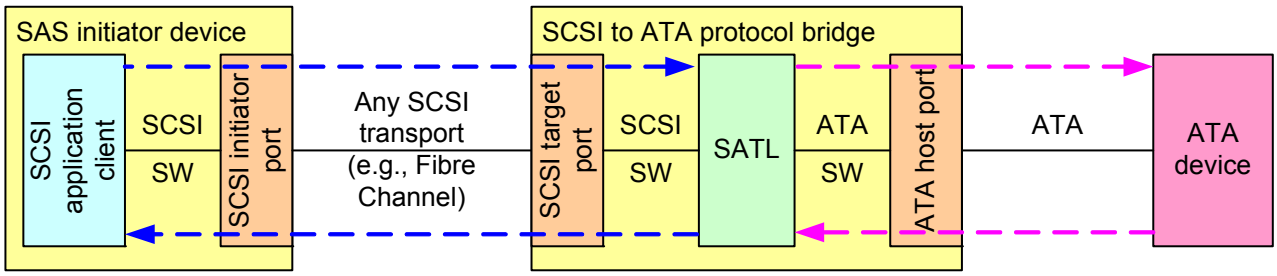


Figure 6 — SATL contained within a SCSI to ATA protocol bridge

EXAMPLE 2 - Figure 7 shows an ATA Host Bus Adapter (HBA) directly connected to an ATA device. The SATL provides SCSI transport protocol layer services to a SCSI application client in accordance with SAM-5.

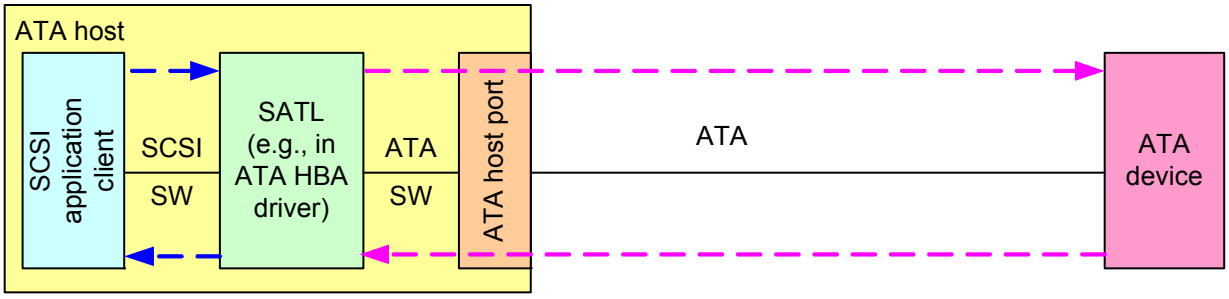


Figure 7 — SATL contained within an ATA host

EXAMPLE 3 - Figure 8 shows an ATA device accessed by a SAS STP initiator port (see SAS-2) through a SAS interconnect. The SAS initiator device includes a SATL to provide the SCSI transport protocol layer services to the application client in accordance with SAM-5.

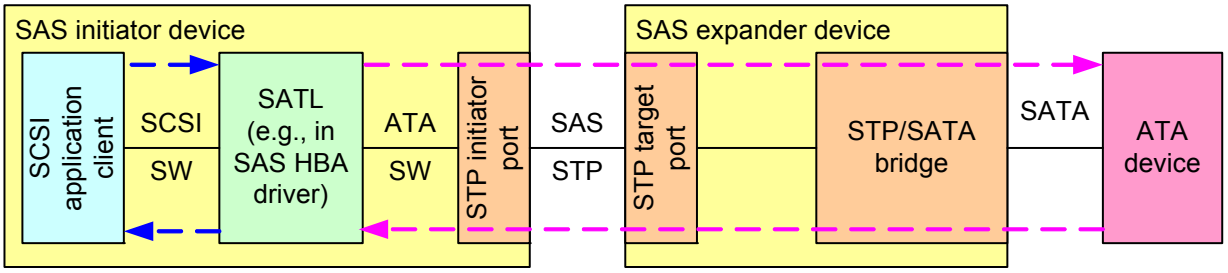


Figure 8 — SATL contained in a SAS initiator device

5.2 Multi-Initiator Configurations

SAM-5defines configurations that may expose multiple I_T nexuses. Operation of a SATL exposed to multiple I_T nexuses are partially specified in this standard.

5.3 Unit attention condition

The SATL shall report events affecting the state of the emulated SCSI device to the SCSI application clients by emulating unit attention conditions (see SAM-5).

A SATL that detects a link reset sequence for a Serial ATA device or initiates any reset of an ATA device shall establish a unit attention condition on behalf of the logical unit corresponding to the ATA device with the sense key set to UNIT ATTENTION and the additional sense code set to POWER ON, RESET, OR BUS DEVICE RESET OCCURRED for the SCSI initiator port associated with each I_T nexus. The method a SATL uses to detect a link reset sequence on the SATA link is vendor specific.

If the SATL detects that the ATA device has initialized new microcode without error, then the SATL shall establish a unit attention condition for the initiator port associated with all I_T nexuses except the I_T nexus on which the set of WRITE BUFFER commands was received, with the additional sense code set to MICROCODE HAS BEEN CHANGED.

The SATL shall report unit attention conditions, in accordance with SAM-5, regardless of whether the condition results from accessing an ATA device or a condition internal to the SATL.

5.4 Handling errors in ATA commands

If a SCSI command is translated into one or more ATA commands and one of the ATA commands completes with an error, the SATL shall terminate processing of the SCSI command and report the error as described in clause 11.

If the SCSI transport protocol for the SATL supports autosense (see 3.1.39), then the SATL shall return the sense data associated with a CHECK CONDITION status using autosense. Otherwise, the SATL shall return contingent allegiance (see SAM-2) sense data in response to the REQUEST SENSE command (see 8.10).

When interpreting data from an ATA command, the SATL shall use the data only if no error was reported for the command. In addition:

a) when interpreting ATA IDENTIFY DEVICE data, if the Integrity word contains the Signature value defined in ACS-3 (i.e., word 255 bits 7:0), then the SATL shall use the data only if the Checksum is correct;
b) when interpreting ATA SMART READ DATA data for the ATA Summary SMART error log (i.e., log address 01h), the ATA Comprehensive SMART error log (i.e., log address 02h), the ATA SMART self-test log (i.e., log address 06h), or the ATA Selective self-test log (i.e., log address 09h) (see ACS-3), the SATL shall use the data only if the data structure checksum (i.e., byte 511) is correct; and
c) when interpreting ATA READ LOG EXT data for the ATA Extended Comprehensive SMART error log (i.e., log address 03h) or ATA Extended SMART self-test log (i.e., log address 07h) (see ACS-3), the SATL shall use the data only if the data structure checksum (i.e., byte 511) is correct.

5.5 ATA nexus loss

An ATA nexus loss event occurs if the SATL loses communication with the SATA device. If an ATA nexus loss event occurs, then:

a) the SATL shall terminate all commands being processed for the corresponding logical unit; and
b) the SATL shall establish a unit attention condition for each I_T nexus with the additional sense code set to:
    A) if the SATL is able to determine that the ATA device is no longer physically present, REPORTED LUNS DATA HAS CHANGED;
    B) if the SATL is unable to determine if the ATA device is physically present or not, INQUIRY DATA HAS CHANGED; or
    C) if the SATL is able to determine that the ATA device is present, INTERNAL TARGET FAILURE.

The method by which the SATL determines physical presence or absence of the ATA device is outside the scope of this standard (e.g., using cold presence detect (see SATA-3.1) or a change in the ELEMENT STATUS CODE field in the Device or Array Device element (see SES-2)).

NOTE 2 - SAM-4 and SPC-4 define how the SATL processes subsequent commands when the logical unit is no longer available (i.e., incorrect logical unit selection).

If the ATA nexus is restored or the SATL detects a power-on condition for an ATA device, then the SATL shall perform the processing described in 5.6 for those events.

5.6 ATA hardware and software reset processing

The hardware reset routines performed by the ATA device include the actions performed by the ATA device for an ATA software reset (see ATA8-AAM), the actions defined in ACS-3, and the applicable ATA transport standards.

An ATA hardware reset may be caused either by the SATL or by the ATA device. If an ATA hardware reset or an ATA software reset occurs except as part of processing a SCSI task management function (see 6.3), then the SATL shall:

a) terminate processing of all commands for each logical unit affected by the reset;
b) restore the ATA volatile settings (see 3.1.34) of the ATA device (e.g., by sending an ATA SET FEATURES command) to values consistent with the saved values of mode pages if savable mode pages are supported and available, or default values if savable mode pages are not supported or are not available; and
c) establish a unit attention condition for each I_T_L nexus with the additional sense code set to POWER ON, RESET, OR BUS DEVICE RESET OCCURRED.

If an ATA hardware reset occurs and the ATA device supports the ATA Sense Data Reporting feature set (i.e., ATA IDENTIFY DEVICE data log SENSE DATA SUPPORTED bit set to one), then the SATL shall send an ATA SET FEATURES - Enable sense data reporting command (i.e., subcommand C3h) to the ATA device.

If the ATA SET FEATURES Enable sense data reporting command completes:

a) without error, then the SATL shall process the Sense Data Available ATA Status bit as described in clause 11; or
b) with error, then the SATL shall ignore the Sense Data Available ATA Status bit.

5.7 Maximum LBA

The maximum LBA to be reported is one less than the largest of the following values that are valid from the ATA IDENTIFY DEVICE data:

a) words 60 through 61;
b) words 100 through 103; or
c) words 230 through 233.

See ACS-3 for the description of when the value in each of these fields is valid.

5.8 Translation of Large Physical Sectors

For SCSI large physical sector operation, see SBC-3 for information on the:

d) Logical Blocks model;
e) Physical Blocks model; and

f) READ CAPACITY(16) command.

For ATA large physical sector operation, see ACS-3 for information on the:

a) Long Logical Sector (LLS) feature set;
b) Long Physical Sector (LPS) feature set;
c) IDENTIFY DEVICE command;
d) Design and programming considerations for large physical sector devices annex; and
e) Implementation Guidelines for 1 024 and 4 096 Byte Sector Sizes annex.

Table 5 describes parameters used in the translation and operation of large physical sectors and where the values for those parameters are found in both SCSI and ATA environments.

Table 5 — Large physical block geometry parameters

Parameter	SCSI	ATA [a]
Logical Sector Size [b]	READ CAPACITY (16) parameter data LOGICAL BLOCK LENGTH IN BYTES field	ATA IDENTIFY DEVICE data log LOGICAL SECTOR SIZE field.
Logical Sectors Per Physical Sector Exponent	READ CAPACITY (16) parameter data LOGICAL BLOCKS PER PHYSICAL BLOCK EXPONENT field	ATA IDENTIFY DEVICE data log LOGICAL TO PHYSICAL SECTOR RELATIONSHIP field.
Logical Sectors Per Physical Sector	$2^{\text{SCSI LOGICAL BLOCKS PER PHYSICAL BLOCK EXPONENT}}$	$2^{\text{ATA LOGICAL TO PHYSICAL SECTOR RELATIONSHIP}}$
Logical Sector Alignment [c]	READ CAPACITY (16) parameter data LOWEST ALIGNED LOGICAL BLOCK ADDRESS field	ATA IDENTIFY DEVICE data log LOGICAL SECTOR OFFSET field

[a] ATA IDENTIFY DEVICE data log provides details on when the data contained in words 106, 117, 118, and 209 are valid.
[b] SCSI Logical Sector Size is measured in bytes, whereas ATA Logical Sector Size is measured in words
[c] The relationship between the SCSI and ATA logical sector alignment is:

SCSI Logical Sector Alignment = (y - (ATA Logical Sector Alignment) modulus y) modulus y

where

y = ATA Logical Sectors Per Physical Sector

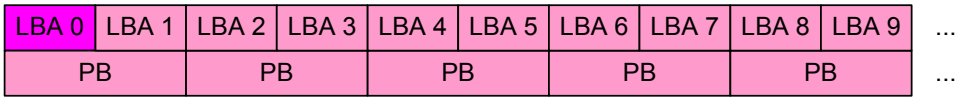
(e.g., If ATA IDENTIFY DEVICE data log LOGICAL TO PHYSICAL SECTOR RELATIONSHIP field is set to 3h and ATA IDENTIFY DEVICE data log LOGICAL SECTOR OFFSET field is set to 0001h, then the SCSI READ CAPACITY (16) parameter data LOWEST ALIGNED LOGICAL BLOCK ADDRESS field is set to 0007h)

Figure 9, figure 10, and figure 11 show examples of physical to logical sector mapping.

Figure 9 — Logical sector alignment example 1

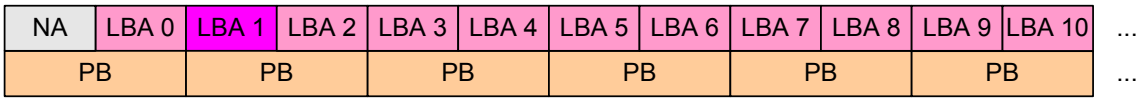
ATA: LOGICAL SECTORS PER PHYSICAL SECTOR field set to 1h
SCSI: LOGICAL BLOCKS PER PHYSICAL BLOCK field set to 0h
(indicating 2^1 logical blocks per physical block)

ATA: LOGICAL SECTOR ALIGNMENT field set to 0h
SCSI: LOWEST ALIGNED LOGICAL BLOCK ADDRESS field set to 0h



ATA: LOGICAL SECTORS PER PHYSICAL SECTOR field set to 1h
SCSI: LOGICAL BLOCKS PER PHYSICAL BLOCK field set to 1h
(indicating 2^1 logical blocks per physical block)

ATA: LOGICAL SECTOR ALIGNMENT field set to 1h
SCSI: LOWEST ALIGNED LOGICAL BLOCK ADDRESS field set to 1h



Key:
LBA n = logical block with LBA n
PB = physical block
NA= not accessible or addressable

The LOGICAL BLOCKS PER PHYSICAL BLOCK field and LOWEST ALIGNED LOGICAL BLOCK ADDRESS field are in the READ CAPACITY (16) command data.

Figure 10 — Logical Sector Alignment Example 2

ATA: LOGICAL SECTORS PER PHYSICAL SECTOR field set to 2h
SCSI: LOGICAL BLOCKS PER PHYSICAL BLOCK field set to 2h
(indicating 2^2 logical blocks per physical block)

ATA: LOGICAL SECTOR ALIGNMENT field set to 0
SCSI: LOWEST ALIGNED LOGICAL BLOCK ADDRESS field set to 0

LBA 0	LBA 1	LBA 2	LBA 3	LBA 4	LBA 5	LBA 6	LBA 7	...
PB				PB				...

ATA: LOGICAL SECTORS PER PHYSICAL SECTOR field set to 2h
SCSI: LOGICAL BLOCKS PER PHYSICAL BLOCK field set to 2h
(indicating 2^2 logical blocks per physical block)

ATA: LOGICAL SECTOR ALIGNMENT field set to 3h
SCSI: LOWEST ALIGNED LOGICAL BLOCK ADDRESS field set to 1h

NA	LBA 0	LBA 1	LBA 2	LBA 3	LBA 4	LBA 5	LBA 6	LBA 7	LBA 8	...
PB			PB			PB				...

ATA: LOGICAL SECTORS PER PHYSICAL SECTOR field set to 2h
SCSI: LOGICAL BLOCKS PER PHYSICAL BLOCK field set to 2h
(indicating 2^2 logical blocks per physical block)

ATA: LOGICAL SECTOR ALIGNMENT field set to 2h
SCSI: LOWEST ALIGNED LOGICAL BLOCK ADDRESS field set to 2h

NA	LBA 0	LBA 1	LBA 2	LBA 3	LBA 4	LBA 5	LBA 6	LBA 7	LBA 8	LBA 9	...
PB			PB			PB					...

ATA: LOGICAL SECTORS PER PHYSICAL SECTOR field set to 2h
SCSI: LOGICAL BLOCKS PER PHYSICAL BLOCK field set to 2h
(indicating 2^2 logical blocks per physical block)

ATA: LOGICAL SECTOR ALIGNMENT field set to 1h
SCSI: LOWEST ALIGNED LOGICAL BLOCK ADDRESS field set to 3h

NA	LBA 0	LBA 1	LBA 2	LBA 3	LBA 4	LBA 5	LBA 6	LBA 7	LBA 8	LBA 9	LBA 10	...
PB				PB			PB					...

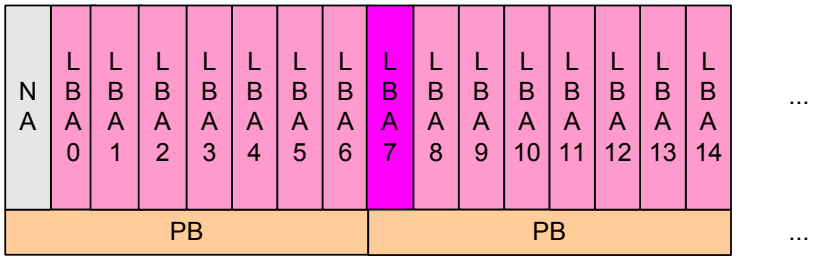
Key:
LBA n = logical block with LBA n
PB = physical block
NA = not accessible and not addressable

The LOGICAL BLOCKS PER PHYSICAL BLOCK field and LOWEST ALIGNED LOGICAL BLOCK ADDRESS field are in the READ CAPACITY (16) command data.

Figure 11 — Logical Sector Alignment Example 3)

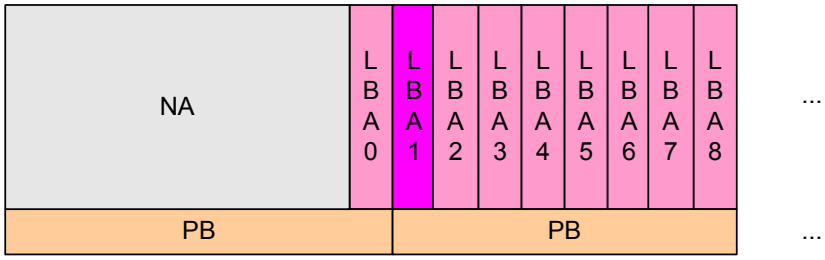
ATA: LOGICAL SECTORS PER PHYSICAL SECTOR field set to 3h
SCSI: LOGICAL BLOCKS PER PHYSICAL BLOCK field set to 3h
(indicating 2^3 logical blocks per physical block)

ATA: LOGICAL SECTOR ALIGNMENT field set to 1h
SCSI: LOWEST ALIGNED LOGICAL BLOCK ADDRESS field set to 7h



ATA: LOGICAL SECTORS PER PHYSICAL SECTOR field set to 1h
SCSI: LOGICAL BLOCKS PER PHYSICAL BLOCK field set to 1h
(indicating 2^3 logical blocks per physical block)

ATA: LOGICAL SECTOR ALIGNMENT field set to 7h
SCSI: LOWEST ALIGNED LOGICAL BLOCK ADDRESS field set to 1h



Key:
LBA n = logical block with LBA n
PB = physical block
NA= not accessible or addressable

The LOGICAL BLOCKS PER PHYSICAL BLOCK field and LOWEST ALIGNED LOGICAL BLOCK ADDRESS field are in the READ CAPACITY (16) command data.

5.9 Reservations

The translation of reservation operations as defined in SPC-4 are unspecified (see 3.4,2), Table 6 defines the behavior of SAT-specific commands in the presence of reservations..

Table 6 — SAT-3 commands that are allowed in the presence of various reservations

Command	Addressed logical unit has this type of persistent reservation held by another I_T nexus				
	From any I_T nexus		From registered I_T nexus (RR all types)	From I_T nexus not registered	
	Write Exclusive	Exclusive Access		Write Exclusive - RR	Exclusive Access - RR
ATA PASS-THROUGH (12)	Conflict	Conflict	Allowed	Conflict	Conflict
ATA PASS-THROUGH(16)	Conflict	Conflict	Allowed	Conflict	Conflict

Key: RR = Registrants Only or All Registrants
Allowed: Commands received from I_T nexuses not holding the reservation or from I_T nexuses not registered if a registrants only or all registrants type persistent reservation is present should complete normally.
Conflict: Commands received from I_T nexuses not holding the reservation or from I_T nexuses not registered if a registrants only or all registrants type persistent reservation is present shall not be performed, and the device server shall complete the command with RESERVATION CONFLICT status.

5.10 ~~Association between commands and CbCS permission bits~~

~~Table 7 defines the Capability based Command Security (i.e., CbCS) permissions required for each command defined in this standard. The permissions shown in table 7 are defined in the permissions bit mask field in the CbCS capability descriptor in a CbCS extension descriptor (see SPC-4). This standard does not define any permissions specific to commands defined in this standard.~~

Table 7 — ~~Associations between commands and CbCS permissions~~

~~Command name~~	~~Permissions bit mask bits~~ [a]				
	~~DATA READ~~	~~DATA WRITE~~	~~PARM READ~~	~~PARM WRITE~~	~~PHY ACC~~
~~ATA PASS-THROUGH (12)~~	~~1~~	~~1~~	~~1~~	~~1~~	
~~ATA PASS-THROUGH(16)~~	~~1~~	~~1~~	~~1~~	~~1~~	

~~[a] A device server shall only process a command shown in this table as specified by the CDB field of an extended CDB (see SPC-4) that contains a CbCS capability descriptor if all of the bits marked with a 1 in the row for that command are set to one in the PERMISSIONS BIT MASK field in that descriptor. The permissions bits represented by the empty cells in a row are ignored. If a device server receives a command specified by the CDB field of an extended CDB that does not contain the CbCS capability descriptor with all of the bits set to one as defined in this table, then the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.~~

6 Command management model

6.1 Overview

A SATL may support the full task management model or the basic task management model as well as specific features of the task management model (e.g., SIMPLE and ORDERED task attributes) depending on the task management capabilities of the SATL and whether the SATL supports NCQ.

6.2 Multiple command processing

6.2.1 Comparison of SCSI task set management and ATA queuing

Examples of the differences between SCSI task set management and ATA queuing methods are shown in table 8.

Table 8 — Comparison of SCSI task set management and ATA queuing methods

Feature [a]	SCSI	NCQ
Ordering	Specified by task attributes (e.g., SIMPLE, ORDERED) associated with each command	Always at the discretion of the device
Queue depth	Indeterminate	Fixed at 1 to 32 commands as reported in the ATA IDENTIFY DEVICE data word 75 bits 4:0
Queue full reporting	TASK SET FULL status	n/a

[a] Queue is a term used to represent a SCSI task set or an ATA queue.

Table 8 — Comparison of SCSI task set management and ATA queuing methods

Feature [a]	SCSI	NCQ
Queue full management	Target device manages and indicates via TASK SET FULL status	ATA host managed
Queued commands	Task set management is applicable to all commands.	Limited to ATA NCQ commands.
Handling of ATA non-queued commands received while one or more ATA queued commands are being processed	n/a	Receipt of any non-NCQ command is an error.
Error handling	Controlled with mode parameters.	Any error aborts all ATA queued commands.
[a] Queue is a term used to represent a SCSI task set or an ATA queue.		

6.2.2 Command translation overview

A SATL that translates SCSI commands to an ATA device using NCQ should implement the SAM-5 task management functions. If the SAM-5 task management functions are not implemented, then the SATL shall implement the basic task management model from SAM-2.

The SATL may implement internal queuing regardless of the version of the SCSI architecture model implemented.

6.2.3 Mapping of SCSI commands to ATA queued commands

A SATL that translates SCSI commands to an ATA device using NCQ, whether or not the SATL also queues commands internally, shall either:

f) indicate support for the basic task management model in standard INQUIRY data (i.e., the BQUE bit is set to one and CMDQUE bit is set to zero), and follow the rules for the basic task management model (see SAM-2); or
g) indicate support for the full task management model in standard INQUIRY data (i.e., the BQUE bit is set to zero and CMDQUE bit is set to one), and set the QERR (i.e., queue error management) field of the Control mode page (see 10.1.6) as follows:
   A) a value of 01b if the SATL does not resend ATA queued commands aborted by the ATA device due to an error condition on any one of the ATA queued commands; or
   B) a value other than 01b if the SATL resends all other ATA queued commands (i.e., except the one in error) aborted by the ATA device due to an error condition on any one of the ATA queued commands.

For each SCSI command that the SATL translates to ATA queued commands (see clause 3.1.25), the SATL shall allocate an available tag value (e.g., for NCQ, the value corresponding to the position of a bit set to zero in the SActive field). The SATL shall maintain a mapping between allocated ATA queued command tags and the corresponding SCSI command identifier. See SAM-5.

The SATL should use the maximum queue depth supported by the ATA device (i.e., indicated by ATA IDENTIFY DEVICE data word 75 bits 4:0), and may either:

a) return a status of TASK SET FULL in response to a SCSI command sent to the corresponding emulated SCSI logical unit if the ATA device represented has the maximum number of ATA queued commands outstanding; or
b) queue the SCSI command and return TASK SET FULL status if the SATL exhausts internal queueing resources.

6.2.4 Commands the SATL queues internally

If the translation of a SCSI command requires the SATL to send an ATA non-queued command to the ATA device, then the SATL shall:

a) suspend processing of the SCSI command, maintain the SCSI command in a task set, and resume processing when the ATA device returns command complete for all ATA commands the SATL has previously sent to the ATA device;
b) return TASK SET FULL status for the SCSI command; or
c) return BUSY status for the SCSI command.

6.2.5 Command queuing with multiple I_T nexuses

In some configurations the SATL may receive SCSI requests from multiple I_T nexuses. If the SATL receives SCSI requests from multiple I_T nexuses (e.g., the configuration shown in figure 6), as specified in SAM-5, the command identifiers maintained in the SATL mapping of command identifiers to NCQ tags shall be qualified by the I_T nexus from which the command was received.If translating from an NCQ tag to the corresponding SCSI command identifier, the SATL shall determine the correct I_T nexus using the qualification information associated with the SCSI command identifier. The SATL may return TASK SET FULL status even if the ATA device has available NCQ tags in order to maintain tags available for other I_T nexuses.

6.2.6 Collateral abort with ATA queued commands

Error conditions with outstanding commands to an ATA device terminate all outstanding ATA commands being processed by the ATA device. An ATA host determines the status and error for each outstanding ATA queued

command affected by the error condition and which ATA command(s) caused the error(s) (see ACS-3 or SATA-3.1). The SATL shall process aborted ATA commands as shown in table 9.

Table 9 — SATL processing of ATA commands aborted by ATA collateral abort

Association between the aborted ATA command and the ATA command that caused the error		Value of the QERR field set in the Control mode page (see 10.1.5)	Method applied by the SATL for processing ATA commands aborted by ATA collateral abort
I_T_L_Q nexus	I_T nexus		
same		00b	The SATL shall terminate the command for the affected I_T_L_Q nexus with CHECK CONDITION status with the sense key and the additional sense code set according to the reported ATA error as described in clause 11.
		01b	
different	same	01b	The SATL shall terminate the affected I_T_L_Q nexus, but the SATL shall neither return status for the I_T_L_Q nexus affected by the aborted ATA command, nor retry the aborted ATA command.
		00b	The SATL shall resend the ATA command and continue processing the corresponding I_T_L_Q nexus.
different		00b	
		01b	The SATL shall terminate the affected I_T_L_Q nexus and establish a unit attention condition (see SAM-4) for the affected initiator port with the additional sense code set to COMMANDS CLEARED BY ANOTHER INITIATOR.

6.3 Command priority

A SATL that supports NCQ may also support SCSI command priority. SCSI command priority supports 16 priorities (0 to 15), whereas SATA NCQ only supports 2 priorities via the PRIO bit in the ATA READ FPDMA QUEUED command, ATA WRITE FPDMA QUEUED command, RECEIVE FPDMA QUEUED command, and SEND FPDMA QUEUED command. The SATL shall translate SCSI command priorities to SATA NCQ priority as shown in Table 10.

Table 10 — Command priority to NCQ PRIO mapping

SCSI command priority	SATA NCQ PRIO bit
0	0
1..3	1
4..15	0

6.4 Task management functions

6.4.1 Task management functions overview

This subclause describes the translation of SCSI task management functions to ATA equivalents.

See Annex A for task management function handling for ATAPI devices.

6.4.2 Aborting ATA queued commands

Some task management functions processed by the SATL may result in ATA commands aborted by ATA collateral abort (see 6.2.6) affecting an I_T_L_Q nexus other than the I_T_L_Q nexus(es) specified in the task management function request. This clause defines the translation for each task management function and defines how the SATL processes the I_T_L_Q nexuses affected by the task management function (e.g., ABORT TASK (see 6.4.4)).

Processing some task management functions requires the SATL to abort one or more ATA commands being processed by an ATA device.

The SATL shall abort an ATA queued command being processed by an ATA device by sending an ATA CHECK POWER MODE command or an ATA log read command requesting log page 10h command to the ATA device.

NOTE 3 - The ATA CHECK POWER MODE command is used to abort ATA queued commands because it is an ATA non-queued command that does not transfer data. The ATA CHECK POWER MODE command does not affect ATA volatile settings.

6.4.3 Aborting ATA non-queued commands

To abort an ATA non-queued command the SATL shall:

a) send an ATA software reset to the ATA device; and
b) restore ATA volatile settings (see 3.1.34) to values consistent with current mode parameter settings.

6.4.4 ABORT TASK

The service request for the ABORT TASK task management function (see SAM-5) is:

Service Response = ABORT TASK (IN (I_T_L_Q nexus)).

If no ATA commands associated with the I_T_L_Q nexus specified in the ABORT TASK task management function are outstanding to the ATA device, then the SATL shall abort the command for the specified I_T_L_Q nexus from the SATL internal context and respond to the ABORT TASK task management function with a service response of FUNCTION COMPLETE (see SAM-4).

If the ATA device is processing one or more ATA commands that are related to the specified I_T_L_Q nexus, then the SATL shall either:

c) allow the ATA command(s) to complete as follows:
   1) wait until the ATA device returns command complete for the ATA command(s);
   2) if the completed ATA command completes processing of the specified I_T_L_Q nexus, then return completion status for the I_T_L_Q nexus; and
   3) return a service response of FUNCTION COMPLETE for the ABORT TASK task management function regardless of whether or not completion status was returned for the I_T_L_Q nexus;

   or
d) abort the ATA command(s) (see 6.4.2) for the specified I_T_L_Q nexus and respond to the ABORT TASK task management function with a service response of FUNCTION COMPLETE.

If aborting the ATA commands related to the specified I_T_L_Q nexus results in one or more other ATA commands being aborted by ATA collateral abort, (see clause 6.2.6) then the SATL shall:

a) if the SATL supports ATA abort retry (see 3.1.7), then re-send all ATA commands aborted by ATA collateral abort (see 6.2.6) and continue processing the affected I_T_L_Q nexuses; or

b) if the SATL does not support ATA abort retry, then for each I_T nex us affected by an ATA command aborted by ATA collateral abort:
   1) terminate all but one of the SCSI commands without returning a function result; and
   2) terminate processing of the remaining SCSI command by returning CHECK CONDITION status with the sense key set to UNIT ATTENTION and additional sense code set to COMMANDS CLEARED BY DEVICE SERVER.

6.4.5 ABORT TASK SET

The service request for the ABORT TASK SET task management function (see SAM-5) is:

Service Response = ABORT TASK SET (IN (I_T_L nexus)).

If the ATA device is not processing ATA commands for SCSI commands associated with the specified I_T_L nexus, then the SATL shall abort all commands for the specified I_T_L nexus from the SATL internal context and respond to the ABORT TASK SET task management function with a service response of FUNCTION COMPLETE.

If the ATA device is processing any ATA commands related to the specified I_T_L nexus, then the SATL shall either:

c) allow the ATA command(s) to complete as follows:
   1) wait until the ATA device returns command complete for the ATA command(s);
   2) if the completed ATA command completes processing a SCSI command in the task set, return completion status for the SCSI command; and
   3) after all ATA commands return completion status, return a service response of FUNCTION COMPLETE for the ABORT TASK SET task management function;

or

d) abort outstanding ATA command(s) (see 6.4.2) for the specified I_T_L nexus, and respond to the ABORT TASK SET task management function with a service response of FUNCTION COMPLETE.

If aborting ATA commands for the specified I_T_L nexus results in ATA commands aborted by ATA collateral abort (see 6.2.6) that are related to processing SCSI commands in an I_T_L nexus other than the specified I_T_L nexus, then:

a) if the SATL supports ATA abort retry (see 3.1.7), then the SATL shall re-send all ATA commands aborted by ATA collateral abort and continue processing of the affected I_T_L_Q nexuses; or
b) if the SATL does not support ATA abort retry, then for each I_T_L nexus other than the specified I_T_L nexus that had one or more SCSI commands affected due to ATA commands aborted by ATA collateral abort, the SATL shall abort all commands for each affected I_T_L nexus and establish a UNIT ATTENTION condition for each affected I_T_L nexus with the additional sense code set to COMMANDS CLEARED BY ANOTHER INITIATOR.

NOTE 4 - A SATL that does not support ATA abort retry (see 3.1.7) is not able to comply with the SAM-5 requirement that ABORT TASK SET not abort commands other than those in the specified I_T_L nexus.

6.4.6 CLEAR ACA

The service request for the CLEAR ACA task management function (see SAM-5) is:

Service Response = CLEAR ACA (IN (I_T_L nexus)).

The SATL shall respond to a CLEAR ACA task management function with a service response of FUNCTION REJECTED.

6.4.7 CLEAR TASK SET

The service request for the CLEAR TASK SET task management function (see SAM-5) is:

Service Response = CLEAR TASK SET (IN (I_T_L nexus)).

If the SATL indicates support for the full task management model (see 6.2.3), then the SATL shall process the CLEAR TASK SET task management function in accordance with a single task set that includes SCSI commands for all I_T_L nexuses (i.e., the TST field in the Control mode page (see clause 10.1.6) is set to 000b .

If the ATA device is processing any ATA commands, then the SATL shall:

a) abort all outstanding ATA command(s);
b) abort all SCSI commands in the task set; and
c) respond to the CLEAR TASK SET task management function with a service response of FUNCTION COMPLETE.

If the SATL aborts commands in the task set for an I_T_L nexus other than the specified I_T_L nexus, then for each other I_T_L nexus, the SATL shall establish a unit attention condition with the additional sense code set to COMMANDS CLEARED BY ANOTHER INITIATOR.

6.4.8 I_T NEXUS RESET

The service request for the I_T NEXUS RESET task management function (see SAM-5) is:

Service Response = I_T NEXUS RESET (IN (I_T nexus)).

If the SATL supports the I_T NEXUS RESET task management function, then the SATL shall process an I_T nexus loss (see 6.6.3) with the additional requirements described in this subclause. If the SATL does not support the I_T NEXUS RESET task management function, then the SATL shall return a service response of FUNCTION REJECTED.

If the ATA device is not processing ATA commands for SCSI commands associated with the specified I_T nexus, then the SATL shall abort all commands for the specified I_T nexus from the SATL internal context and respond to the I_T NEXUS RESET task management function with a service response of FUNCTION COMPLETE.

If the ATA device is processing any ATA commands related to the specified I_T nexus, then the SATL shall either:

d) allow the ATA command(s) to complete as follows:
   1) wait until the ATA device returns command complete for the ATA command(s);
   2) if the completed ATA command completes processing a SCSI command in the task set, return completion status for the SCSI command; and
   3) after all ATA commands return completion status, return a service response of FUNCTION COMPLETE for the I_T NEXUS RESET task management function;

or

e) abort outstanding ATA command(s) (see 6.4.2) for the specified I_T nexus, and respond to the I_T NEXUS RESET task management function with a service response of FUNCTION COMPLETE.

The SATL shall establish a unit attention condition on behalf of the logical unit corresponding to the ATA device with an additional sense code set to I_T NEXUS LOSS OCCURRED.

If aborting ATA commands for the specified I_T nexus results in ATA commands being aborted by ATA collateral abort (see clause 6.2.6) that are related to processing SCSI commands in an I_T nexus other than the specified I_T nexus, then:

a) if the SATL supports ATA abort retry (see clause 3.1.7), then the SATL shall re-send all ATA commands aborted by ATA collateral abort, continue processing of the affected I_T_L_Q nexuses, and respond to the I_T NEXUS RESET task management function with a service response of FUNCTION COMPLETE; or
b) if the SATL does not support ATA abort retry, then for each I_T nexus other than the specified I_T nexus that had one or more SCSI commands affected due to ATA commands aborted by ATA collateral abort, the SATL shall abort all commands for each affected I_T nexus, establish a unit attention condition with the additional sense code set to COMMANDS CLEARED BY ANOTHER INITIATOR, and respond to the I_T NEXUS RESET task management function with a service response of FUNCTION COMPLETE.

NOTE 5 - A SATL that does not support ATA abort retry (see clause 3.1.7) is not able to comply with the SAM-5 requirement that I_T NEXUS RESET not abort commands other than those in the specified I_T nexus.

6.4.9 LOGICAL UNIT RESET

The service request for the LOGICAL UNIT RESET task management function (see SAM-5) is:

Service Response = LOGICAL UNIT RESET (IN (I_T_L nexus)).

The SATL shall process a logical unit reset (see 6.6.4), then return a service response of FUNCTION COMPLETE for the LOGICAL UNIT RESET task management function.

6.4.10 QUERY TASK

The service request for the QUERY TASK task management function (see SAM-5) is:

Service Response = QUERY TASK (IN (I_T_L_Q nexus)).

If the SATL supports the QUERY TASK task management function, then:

a) the SATL shall return a service response of FUNCTION SUCCEEDED if the specified I_T_L_Q nexus is in the task set; or
b) the SATL shall return a service response of FUNCTION COMPLETE if the specified I_T_L_Q nexus is not in the task set.

If the SATL supports the QUERY TASK task management function, the SATL may return the Additional Response Information as specified in SAM-5.

If the SATL does not support the QUERY TASK task management function then the SATL shall return a service response of FUNCTION REJECTED.

6.4.11 QUERY TASK SET

The service request for the QUERY TASK SET task management function (see SAM-5) is:

Service Response = QUERY TASK SET (IN (I_T_L nexus)).

If the SATL supports the QUERY TASK SET task management function, then:

a) the SATL shall return a service response of FUNCTION SUCCEEDED if there is any command present in the task set from the specified I_T_L nexus; or
b) the SATL shall return a service response of FUNCTION COMPLETE if there is no command present in the specified I_T_L nexus.

If the SATL does not support the QUERY TASK SET task management function the SATL shall return a service response of FUNCTION REJECTED.

6.4.12 QUERY ASYNCHRONOUS EVENT

The service request for the QUERY ASYNCHRONOUS EVENT task management function (see SAM-4) is:

Service Response = QUERY ASYNCHRONOUS EVENT (IN (I_T_L nexus), OUT ([Additional Response Information])).

If the SATL supports the QUERY ASYNCHRONOUS EVENT task management function, then the SATL shall:

c) if there is a unit attention condition or deferred error pending for the specified I_T nexus return a service response of FUNCTION SUCCEEDED; or
d) if there is no unit attention condition and no deferred error pending for the specified I_T nexus return a service response of FUNCTION COMPLETE.

If the SATL supports the QUERY ASYNCHRONOUS EVENT task management function, then the SATL shall return the Additional Response Information as specified in SAM-5.

If the SATL does not support the QUERY ASYNCHRONOUS EVENT task management function the SATL shall return a service response of FUNCTION REJECTED.

6.4.13 Reset task management functions

The TARGET RESET task management function (see SAM-2) is may be used by a SCSI application client to cause a hard reset (i.e., similar to a power-on condition) for each logical unit of a specified target device. The SATL may process the TARGET RESET task management function by issuing an ATA hardware reset (see 3.1.14) to the ATA device(s) associated with the target device.

6.5 CONTROL Byte

Table 11 describes SATL handling of the CDB CONTROL byte. See SAM-5 for CONTROL byte details.

Table 11 — CONTROL byte fields

Field	Description
Vendor specific	The SATL may use this field for vendor-specific purposes.
NACA	If set to one, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

6.6 Conditions resulting from SCSI events translations

6.6.1 Conditions resulting from SCSI events translations overview

Table 12 describes the translations for conditions resulting from SCSI events (see SAM-5).

Table 12 — SAM conditions

Condition	Description or reference
Power on	Unspecified (see 3.4.2)
Hard reset	6.6.2
I_T nexus loss	6.6.3
Logical unit reset	6.6.4
Power loss expected	6.6.5

6.6.2 Hard reset

To process a hard reset (see SAM-5), the SATL shall perform the actions defined in SAM-5.

In addition to the reset events defined in SAM-5 and other standards, the SATL shall include the following as reset events:

a) an ATA device that is a SATA device performing asynchronous signal recovery (see SATA-3.1); and
b) sending an ATA hardware reset to the ATA device for reasons other than those described in 5.6 (e.g., see 6.4.9, 6.4.13, and 12.2.2.2).

6.6.3 I_T nexus loss

Processing of an I_T nexus loss (see SAM-5) depends on whether the SATL provides multiple I_T nexuses access to the emulated SCSI logical unit. See Annex A for I_T nexus loss handling for ATAPI devices.

If the SATL does not provide multiple I_T nexuses access to the emulated SCSI logical unit, then the SATL shall handle the I_T nexus loss by performing the actions defined in SAM-5 with the following additional requirements:

1) abort any outstanding ATA command(s) (see 6.4.2 and 6.4.3);
2) delete all commands in the task set from the SATL internal context; and
3) establish a unit attention condition for the affected I_T nexus with the additional sense code set to I_T NEXUS LOSS OCCURRED.

If the SATL provides multiple I_T nexuses access to the emulated SCSI logical unit, then the SATL shall handle the I_T nexus loss by performing the actions defined in SAM-5 with the following additional requirements:

1) allow any outstanding ATA command(s) for each I_T nexus that is not lost to complete;
2) abort any remaining ATA command(s) (see 6.4.2 and 6.4.3);
3) delete all commands in the task set from the SATL internal context for commands associated with the I_T nexus that the I_T nexus loss event occurred; and
4) establish a unit attention with the additional sense code set to I_T NEXUS LOSS OCCURRED for the SCSI initiator port associated with the I_T nexus that was lost.

6.6.4 Logical unit reset

To process a logical unit reset, the SATL shall perform the actions defined in SAM-5 with the following additional requirements:

1) reset the ATA device as follows:
   1) optionally send an ATA software reset (see 3.1.30) to the ATA device; and
   2) if the ATA software reset is not successful or not sent, then send an ATA hardware reset (see 3.1.14) to the ATA device;

   NOTE 6 - It is vendor-specific how the SATL determines if the ATA software reset is successful.

2) abort all commands in the task set from the SATL internal context;
3) restore ATA volatile settings (see 3.1.34) to values consistent with the emulation of saved or default values of mode parameters, log parameters, and INQUIRY data (see SPC-4); and
4) establish a unit attention condition (see SAM-5).

   NOTE 7 - If more than one PATA device is present on a PATA bus, then issuing an ATA software reset causes both PATA devices to be reset.

6.6.5 Power loss expected

To process a power loss expected (see SAM-5), the SATL shall:

1) if any queued command has been issued to the ATA device and not completed or if no commands are outstanding at the ATA device, then issue an ATA IDLE IMMEDIATE command to the ATA device using the unload feature (see ACS-3);
2) if an ATA non-queued command is outstanding at the ATA device, then issue an ATA reset followed by an ATA IDLE IMMEDIATE command to the ATA device using the unload feature (see ACS-3); and
3) perform the actions defined in SAM-5.

6.7 Medium access and stopped state

If a SATL receives a SCSI medium access command while in the stopped power condition (see SBC-3), then the SATL shall return CHECK CONDITION status, with the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED.

7 Summary of SCSI / ATA command mappings

In the event of a discrepancy between the contents of this clause and the description of individual commands, description of individual commands shall apply.

Clause 7, clause 8, and clause 9 describe the SCSI to ATA command mapping for ATA devices emulating a SCSI logical unit with a peripheral device type of 00h (i.e., direct-access block device) or 14h (i.e., host managed zoned device). Command transmission requirements for ATAPI devices are described in Annex A.

The SATL shall queue received SCSI commands as necessary to ensure the SATL does not send more than one ATA command to the ATA device representing the logical unit with the exception of ATA queued commands (see clause 3.1.25).Table 13 lists the SCSI / ATA command mappings defined in this standard. A SATL may implement commands defined in SPC-4 and SBC-3, but not listed in table 13. Translation of commands not listed in table 13 is vendor-specific.

Table 13 — Summary of SCSI / ATA command mapping (part 1 of 3)

SCSI command	ATA command(s)[a]	Reference
ATA PASS-THROUGH (12)	Any	12.2.2.2
ATA PASS-THROUGH (16)		12.2.2.3
CLOSE ZONE	CLOSE ZONE EXT	
FINISH ZONE	FINISH ZONE EXT	
FORMAT UNIT	READ VERIFY SECTORS, READ VERIFY SECTORS EXT, WRITE SECTORS, or WRITE SECTORS EXT	9.4
INQUIRY	IDENTIFY DEVICE	8.1
LOG SELECT	Log page dependent (see 10.2)	8.2
LOG SENSE	Log page dependent (see 10.2)	8.3
MODE SELECT (6)	Mode page dependent (see 10.1)	8.4
MODE SELECT (10)		8.5
MODE SENSE (6)		8.6
MODE SENSE (10)		8.7
OPEN ZONE	OPEN ZONE EXT	
READ (10)	See 9.1	9.7
READ (12)		9.8
READ (16)		9.9
READ BUFFER	READ BUFFER, ATA read log	8.8

[a] Translations for SCSI commands may require one or more of the ATA commands listed to be sent to the ATA device

Table 13 — Summary of SCSI / ATA command mapping (part 2 of 3)

SCSI command	ATA command(s)[a]	Reference
READ CAPACITY (10)	IDENTIFY DEVICE	9.10
READ CAPACITY (16)		9.11
REASSIGN BLOCKS	READ VERIFY SECTOR(S), READ VERIFY SECTOR(S) EXT, WRITE DMA, WRITE DMA EXT, WRITE DMA FUA EXT, WRITE DMA QUEUED, WRITE DMA QUEUED EXT, WRITE DMA QUEUED FUA EXT, or WRITE FPDMA QUEUED	9.12
REPORT LUNS	n/a	SPC-4
REPORT SUPPORTED OPERATION CODES	n/a	SPC-4
REPORT TIMESTAMP	ATA read log command (see 3.1.28)	8.9
REPORT ZONES	REPORT ZONES EXT	
REQUEST SENSE	SMART RETURN STATUS, CHECK POWER MODE, and SANITIZE STATUS EXT	8.10
RESET WRITE POINTER	RESET WRITE POINTER	
SANITIZE	SANITIZE DEVICE	9.15
SECURITY PROTOCOL IN	TRUSTED RECEIVE, TRUSTED RECEIVE DMA, or TRUSTED NON-DATA	8.11
SECURITY PROTOCOL OUT	TRUSTED SEND, TRUSTED SEND DMA, or TRUSTED NON-DATA	8.12
SEND DIAGNOSTIC	SMART EXECUTE OFF-LINE IMMEDIATE	8.13
SET TIMESTAMP	SET DATE & TIME EXT	8.14
START STOP UNIT	FLUSH CACHE, FLUSH CACHE EXT, STANDBY, IDLE IMMEDIATE, READ VERIFY SECTOR(S), READ VERIFY SECTOR(S) EXT, ATA verify commands, ATA flush commands, or STANDBY IMMEDIATE	9.16
SYNCHRONIZE CACHE (10)	FLUSH CACHE or FLUSH CACHE EXT	9.17
SYNCHRONIZE CACHE (16)		9.18
TEST UNIT READY	CHECK POWER MODE and SANITIZE STATUS EXT	8.15
UNMAP	DATA SET MANAGEMENT	9.19

[a] Translations for SCSI commands may require one or more of the ATA commands listed to be sent to the ATA device

Table 13 — Summary of SCSI / ATA command mapping (part 3 of 3)

SCSI command	ATA command(s)[a]	Reference
VERIFY (10)	See 9.1	9.20
VERIFY (12)		9.21
VERIFY (16)		9.22
WRITE (10)	See 9.1	9.24
WRITE (12)		9.25
WRITE (16)		9.26
WRITE AND VERIFY (10)	See 9.1	9.28
WRITE AND VERIFY (12)		9.29
WRITE AND VERIFY (16)		9.30
WRITE BUFFER	WRITE BUFFER, DOWNLOAD MICROCODE, or DOWNLOAD MICROCODE DMA	8.16
WRITE LONG (10)	WRITE UNCORRECTABLE EXT	9.31
WRITE LONG (16)		9.32
WRITE SAME (10)	See 9.1	9.33
WRITE SAME (16)		9.34

[a] Translations for SCSI commands may require one or more of the ATA commands listed to be sent to the ATA device

8 SCSI Primary Commands (SPC) command mapping

8.1 INQUIRY command

8.1.1 INQUIRY command overview

The INQUIRY command requests general information about a logical unit and target device. The INQUIRY command and selected VPD pages shall be emulated using information from the ATA IDENTIFY DEVICE command and other information (see 8.1.2). The SATL shall send an ATA IDENTIFY DEVICE command to the ATA device. Table 14 describes the emulation of fields in the INQUIRY CDB.

Table 14 — INQUIRY CDB field translations

Field	Description or reference
OPERATION CODE	Set to 12h.
EVPD	Unspecified.(see clause 3.4.2).
PAGE CODE[a]	The SATL: a) shall support the Supported VPD Pages VPD page (00h) (see 10.3.2); b) may support the Unit Serial Number VPD page (80h) (see 10.3.3); c) shall support the Device Identification VPD page (83h) (see 10.3.4); d) should support the Mode Page Policy VPD page (87h) (see 10.3.5); e) shall support the ATA Information VPD page (89h) (see 12.4.2); f) may support the Power Condition VPD page (8Ah) (see 10.3.7); g) may support the Block Limits VPD page (B0h) (see 10.3.9); h) may support the Block Device Characteristics VPD page (B1h) (see 10.3.8)~~, and~~; i) may support the Logical Block Provisioning VPD page (B2h) (see 10.3.10)~~.~~, and j) may support the Zoned Block Device Characteristics VPD page (B6h) (see 10.3.11)
ALLOCATION LENGTH	Unspecified.(see clause 3.4.2).
CONTROL	6.5

[a] VPD page translations are defined in 10.3 and 12.4.2.

8.1.2 Standard INQUIRY data

Table 15 describes the standard INQUIRY data fields supported by the SATL.

Table 15 — Standard INQUIRY data fields (part 1 of 3)

Field	Description or reference
PERIPHERAL QUALIFIER	The SATL shall set this field to 000b to indicate that the peripheral device is currently connected to this logical unit.[a]
PERIPHERAL DEVICE TYPE	If the device is an ATA host managed zoned device (see 3.1.17), the SATL shall set this field to 14h to indicate this. Otherwise, the~~The~~ SATL shall set this field to 00h to indicate that the peripheral device is a direct access block device.[a]
RMB	Unspecified (see 3.4.2)
VERSION	The VERSION field indicates the version of SPC to which the SATL complies (see SPC-4) (e.g., 06h for SPC-4).
NORMACA	The SATL shall set this bit to zero to indicate the SATL does not support the NACA bit in the CONTROL byte (see 6.5).
HISUP	Unspecified (see 3.4.2)
RESPONSE DATA FORMAT	The SATL shall set this field to 2h.
ADDITIONAL LENGTH	The SATL shall set this field to the length of the INQUIRY data that follows.
SCCS	Unspecified (see 3.4.2)
ACC	Unspecified (see 3.4.2)
TPGS	Unspecified (see 3.4.2)
3PC	Unspecified (see 3.4.2)
PROTECT	Unspecified (see 3.4.2)
ENCSERV	Unspecified (see 3.4.2)
VS	Unspecified (see 3.4.2)
MULTIP	Unspecified (see 3.4.2)
ADDR16	Unspecified (see 3.4.2)
WBUS16	Unspecified (see 3.4.2)

[a] If the INQUIRY command is sent to an incorrect logical unit then the SATL shall set the PERIPHERAL QUALIFIER field to 011b and shall set the PERIPHERAL DEVICE TYPE field to 1Fh.
[b] See 3.5.4.
[c] The full ATA IDENTIFY DEVICE data Model number field contents and the Firmware revision field contents are returned in the ATA Information VPD page (see 12.4.2).
[d] The encoding used by the SPC-4 standard for INQUIRY version descriptors and the encoding used by the ACS-3 standard for ATA IDENTIFY DEVICE major and minor version numbers differ. The two standards may not define values for the same revisions.

Table 15 — Standard INQUIRY data fields (part 2 of 3)

Field	Description or reference
SYNC	Unspecified (see 3.4.2)
CMDQUE	Unspecified (see 3.4.2)
T10 VENDOR IDENTIFICATION	The SATL shall set the T10 VENDOR IDENTIFICATION field to 'ATA¬¬¬¬¬¬' [b].
PRODUCT IDENTIFICATION [c]	The SATL shall set the PRODUCT IDENTIFICATION field to a representation of the first 16 bytes of the ATA IDENTIFY DEVICE data Model number field, where each pair of bytes are swapped to create a valid ASCII string format: 1) byte 0 contains ATA IDENTIFY DEVICE word 27 bits 15:8 (i.e., byte 1); 2) byte 1 contains ATA IDENTIFY DEVICE word 27 bits 7:0 (i.e., byte 0); 3) byte 2 contains ATA IDENTIFY DEVICE word 28 bits 15:8 (i.e., byte 3); 4) byte 3 contains ATA IDENTIFY DEVICE word 28 bits 7:0 (i.e., byte 2); ... 1) byte 14 contains ATA IDENTIFY DEVICE word 34 bits 15:8 (i.e., byte 15); and 2) byte 15 contains ATA IDENTIFY DEVICE word 34 bits 7:0 (i.e., byte 14).
PRODUCT REVISION LEVEL [c]	The SATL shall set the PRODUCT REVISION LEVEL field to a four byte ASCII character representation of the ATA IDENTIFY DEVICE data Firmware revision field. Each pair of bytes are swapped to create a valid ASCII string format. Since the ATA IDENTIFY DEVICE data Firmware revision field contains eight ASCII characters and the standard INQUIRY data PRODUCT REVISION LEVEL field is four ASCII characters, the SATL shall select four of the eight ASCII characters from the ATA IDENTIFY DEVICE data Firmware revision field to return in the PRODUCT REVISION LEVEL field as follows: a) If the ATA IDENTIFY DEVICE data words 25 to 26 are set to four ASCII spaces (i.e., 2020_2020h), then the four ASCII characters selected shall contain: 1) byte 0 contains ATA IDENTIFY DEVICE data word 23 bits 15:8 (i.e., byte 1); 2) byte 1 contains ATA IDENTIFY DEVICE data word 23 bits 7:0 (i.e., byte 0); 3) byte 2 contains ATA IDENTIFY DEVICE data word 24 bits 15:8 (i.e., byte 3); and 4) byte 3 contains ATA IDENTIFY DEVICE data word 24 bits 7:0 (i.e., byte 2); or b) If the ATA IDENTIFY DEVICE data words 25 to 26 are not set to four ASCII spaces (i.e., 2020_2020h), then the four ASCII characters selected shall contain: 5) byte 0 contains ATA IDENTIFY DEVICE data word 25 bits 15:8 (i.e., byte 5); 6) byte 1 contains ATA IDENTIFY DEVICE data word 25 bits 7:0 (i.e., byte 4); 7) byte 2 contains ATA IDENTIFY DEVICE data word 26 bits 15:8 (i.e., byte 7); and 8) byte 3 contains ATA IDENTIFY DEVICE data word 26 bits 7:0 (i.e., byte 6).
CLOCKING	Unspecified (see 3.4.2)

[a] If the INQUIRY command is sent to an incorrect logical unit then the SATL shall set the PERIPHERAL QUALIFIER field to 011b and shall set the PERIPHERAL DEVICE TYPE field to 1Fh.

[b] See 3.5.4.

[c] The full ATA IDENTIFY DEVICE data Model number field contents and the Firmware revision field contents are returned in the ATA Information VPD page (see 12.4.2).

[d] The encoding used by the SPC-4 standard for INQUIRY version descriptors and the encoding used by the ACS-3 standard for ATA IDENTIFY DEVICE major and minor version numbers differ. The two standards may not define values for the same revisions.

Table 15 — Standard INQUIRY data fields (part 3 of 3)

Field	Description or reference
QAS	Unspecified (see 3.4.2)
IUS	Unspecified (see 3.4.2)
VERSION DESCRIPTOR 1 to VERSION DESCRIPTOR 8	The SATL shall include version descriptors (see SPC-~~4~~5) for: a) the SCSI Architecture Model standard (e.g., SAM-5); b) this standard; c) the SCSI Primary Commands standard (e.g., SPC-5~~4~~); d) the SCSI Block Commands standard (e.g., SBC-4~~3~~); e) the SCSI Zoned Block Commands standard (e.g., ZBC), if appropriate; f) if the SATL receives SCSI commands through a SCSI target port (see figure 6 in 5.1), the version of the transport protocol to which the SCSI target port was designed; g) if the SATL sends ATA commands through a SAS STP initiator port (see figure 8 in 5.1), the version of SAS (e.g., ~~SAS-2~~SPL-3) to which the SAS STP initiator port was designed; and h) the version(s) of ATA standards (e.g., ACS-~~3~~4 and ATA8-AAM) to which the ATA device claims compliance in A) ATA IDENTIFY DEVICE data word 80 (i.e., Major version number), B) ATA IDENTIFY DEVICE data word 81 (i.e., Minor version number), C) ATA IDENTIFY DEVICE data word 222,and D) ATA IDENTIFY DEVICE data word 223. [d]
Vendor specific parameters	Unspecified (see 3.4.2)

[a] If the INQUIRY command is sent to an incorrect logical unit then the SATL shall set the PERIPHERAL QUALIFIER field to 011b and shall set the PERIPHERAL DEVICE TYPE field to 1Fh.
[b] See 3.5.4.
[c] The full ATA IDENTIFY DEVICE data Model number field contents and the Firmware revision field contents are returned in the ATA Information VPD page (see 12.4.2).
[d] The encoding used by the SPC-4 standard for INQUIRY version descriptors and the encoding used by the ACS-3 standard for ATA IDENTIFY DEVICE major and minor version numbers differ. The two standards may not define values for the same revisions.

8.2 LOG SELECT command

8.2.1 LOG SELECT command overview

The LOG SELECT command provides a means for the application client to manage statistical information maintained by the SCSI target device about the SCSI device target or its logical units. Table 16 shows the translations of the fields specified in the LOG SELECT CDB.

Table 16 — LOG SELECT CDB field translations

Field	Description or reference
OPERATION CODE	Set to 4Ch.
PCR	Unspecified (see 3.4.2).
SP	Unspecified (see 3.4.2).
PC	8.2.2
PAGE CODE	8.2.3
SUBPAGE CODE	8.2.3
PARAMETER LIST LENGTH	Unspecified (see 3.4.2)..
CONTROL	6.5

8.2.2 PC field translations

Table 17 shows the SATL interpretation of the PC field.

Table 17 — PC field translation

Code	Translation
00b	Unspecified (see 3.4.2)
01b	Supported
10b	Unspecified (see 3.4.2)
11b	Unspecified (see 3.4.2)

8.2.3 PAGE CODE field and SUBPAGE CODE field translations

SATL emulation of the page code and subpage code is shown in table 18.

Table 18 — LOG SELECT PAGE CODE field and SUBPAGE CODE field translations

Page Code	Subpage Code	Description or reference
0Fh	00h	Application client log page. See 10.2.2 for the translation of the application client log page.
All others		Unspecified (see 3.4.2)

8.3 LOG SENSE command

8.3.1 LOG SENSE command overview

The LOG SENSE command provides a means for the application client to retrieve statistical or otheroperational information maintained by the SCSI target device about the SCSI target device or its logical units.
The SATL shall implement support for this field by returning the log page data for the particular page requested.

Table 19 shows the translation for fields specified in the LOG SENSE CDB.

Table 19 — LOG SENSE CDB field translations

Field	Description or reference
OPERATION CODE	Set to 4Dh.
SP	Unspecified (see 3.4.2)
PC	8.3.2
PAGE CODE	8.3.3
SUBPAGE CODE	Unspecified (see 3.4.2)
PARAMETER POINTER	Unspecified (see 3.4.2)
ALLOCATION LENGTH	Unspecified (see 3.4.2).
CONTROL	6.5

8.3.2 PC (page control) field

The SATL interpretation and support of the page control values is shown in table 20.

Table 20 — PC field

Code	SAT Translation
00b	Unspecified (see 3.4.2)
01b	Supported
10b	Unspecified (see 3.4.2)
11b	Unspecified (see 3.4.2)

8.3.3 PAGE CODE and SUB PAGE CODE fields

The SATL shall support these field as defined in SPC-4. The SATL emulation for support of the PAGE CODE field is provided in table 21.

Table 21 — PAGE CODE / SUB PAGE CODE fields

Page Code	Subpage Code	Description
00h	00h	Supported Log Pages log page: The SATL shall implement this page by returning a list of supported log pages (see 10.2.3).
10h	00h	Self-Test Results log page: The SATL shall determine if the ATA SMART self-test is supported from the ATA IDENTIFY DEVICE data log SMART SELF-TEST SUPPORTED bit . a) If the ATA SMART self-test is not supported (i.e., SMART SELF-TEST SUPPORTED bit is set to zero) then the SATL shall return a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB. b) If the ATA SMART self-test is supported (i.e., SMART SELF-TEST SUPPORTED bit is set to one) then the SATL shall return the translated Self-Test Results log page to the application client (see 10.2.5).
2Fh	00h	Informational Exceptions log page: The SATL shall determine if the ATA SMART feature set is supported from the ATA IDENTIFY DEVICE data log SMART bit. 1) If the ATA SMART feature set is not supported (i.e., SMART is set to zero) then the SATL shall return a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB. 2) If the ATA SMART feature set is supported (i.e., SMART is set to one) then the SATL shall determine if the ATA SMART feature set is enabled or disabled from the ATA IDENTIFY DEVICE data log SMART ENABLED bit. A) If the ATA SMART feature set is disabled (i.e., SMART ENABLED is set to zero) then the SATL shall return a CHECK CONDITION status with the sense key set to ABORTED COMMAND and additional sense code set to ATA DEVICE FEATURE NOT ENABLED. B) If the ATA SMART feature set is enabled (i.e., SMART ENABLED is set to one) then the SATL shall return the translated Informational Exceptions log page to the application client (see 10.2.6.1).
All others	All	Unspecified (see 3.4.2)

8.4 MODE SELECT (6) command

8.4.1 MODE SELECT (6) command overview

The MODE SELECT(6) command (see SPC-4) provides a means for an application client to specify medium, logical unit, or peripheral device parameters to a device server in the SATL. Device servers that implement the MODE SELECT (6) command shall also implement the MODE SENSE (6) command. Application clients should

send a MODE SENSE (6) command prior to each MODE SELECT (6) command to determine supported mode pages, changeable fields, page lengths, and other parameters.

The SATL shall modify logical unit, or peripheral device parameters for supported mode pages and parameters as specified in mode pages received from the application client. Some operational parameters in individual pages are provided via ATA (see 10.1).

The Mode Page Policy VPD page (see 10.3.5) should be implemented. After a logical unit reset, the SATL shall set all emulated or translated mode page values to saved or default values. See 10.1 for supported mode pages.

8.4.2 MODE SELECT (6) CDB fields

The SATL shall support MODE SELECT (6) CDB fields as shown in table 22.

Table 22 — MODE SELECT (6) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 15h.
PF	If this bit is set to zero (i.e., specifies that mode pages are vendor specific), then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB. The SATL shall support this bit being set to one (i.e., specifies that all mode page formats correspond to SPC-4 and SBC-3 mode page formats).
SP	Unspecified (see 3.4.2)
PARAMETER LIST LENGTH	Unspecified (see 3.4.2)
CONTROL	6.5

8.5 MODE SELECT (10) command

The MODE SELECT (10) command (see SPC-4) provides a means for an application client to set parameters in the device server in a SATL. It is a complementary command to the MODE SENSE(10) command and shall be implemented as described in Table 23.

Table 23 — MODE SELECT (10) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 55h.
PF	As specified for MODE SELECT (6), see 8.4
SP	As specified for MODE SELECT (6), see 8.4
PARAMETER LIST LENGTH	As specified for MODE SELECT (6), see 8.4
CONTROL	As specified for MODE SELECT (6), see 8.4

Device servers that implement the MODE SELECT (10) command shall also implement the MODE SENSE (10) command. See 10.1 for supported mode pages.

8.6 MODE SENSE (6) command

8.6.1 MODE SENSE (6) command overview

The MODE SENSE (6) command (see SPC-4) provides a means for a device server in a SATL to report parameters to an application client. It is a complementary command to the MODE SELECT(6) command. The SATL shall return the requested mode pages to the application client. Some operational parameters in individual pages are gathered by issuing ATA commands (see 10.1).

Device servers that implement the MODE SENSE (6) command shall also implement the MODE SELECT(6) command. See 10.1 for supported mode pages.

8.6.2 MODE SENSE (6) CDB fields

The SATL shall support MODE SENSE (6) CDB fields as shown in table 24.

Table 24 — MODE SENSE (6) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 1Ah.
DBD	A DBD bit set to zero specifies that zero or more block descriptors may be returned in MODE SENSE data. The SATL shall support only the mode parameter block descriptor format for direct-access block devices.
PC	Current values (i.e., the PC field is set to 00b) shall be supported. Reporting changeable, saveable, and default values is unspecified (see 3.4.2).
PAGE CODE	This field specifies the particular mode page requested (see 10.1). If the SATL does not support the specified mode page, then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.
SUB PAGE CODE	This field specifies the sub page code within the page code specified by PAGE CODE field that is requested by the application client (see 10.1).
ALLOCATION LENGTH	Unspecified (see 3.4.2)
CONTROL	6.5

8.7 MODE SENSE (10) command

The MODE SENSE (10) command (see SPC-4) provides a means for a device server in a SATL to report parameters to an application client. It is a complementary command to the MODE SELECT(10) command and shall be implemented as shown in table 25.

Table 25 — MODE SENSE (10) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 5Ah.
LLBA	Unspecified (see 3.4.2)
DBD	As defined for MODE SELECT (6), see 8.6
PC	As defined for MODE SELECT (6), see 8.6
PAGE CODE	As defined for MODE SELECT (6), see 8.6
SUB PAGE CODE	As defined for MODE SELECT (6), see 8.6
ALLOCATION LENGTH	As defined for MODE SELECT (6), see 8.6
CONTROL	As defined for MODE SELECT (6), see 8.6

SATLs that implement the MODE SENSE (10) command shall also implement the MODE SELECT(10) command. See 10.1 for supported mode pages.

8.8 READ BUFFER command

8.8.1 READ BUFFER command overview

The READ BUFFER command (see SPC-4) is used in conjunction with the WRITE BUFFER command as a diagnostic function for testing memory in the SCSI device and the integrity of a service delivery subsystem. This command shall not alter the medium.

The SATL shall:

a) send an ATA READ BUFFER command to the ATA device; ~~or~~
b) send an ATA read log command to the ATA device; or
c) emulate the specified function, if supported;

depending on the values for the BUFFER ID field and MODE field (see 8.8.2.1).

Table 26 shows the translation for fields specified in the CDB for the READ BUFFER command.

Table 26 — READ BUFFER CDB field translations

Field	Description or reference
OPERATION CODE	Set to 3Ch.
MODE	8.8.2
MODE SPECIFIC	The translation of this field depends on the contents of the MODE field (see 8.8.2.1).
BUFFER ID	~~If the BUFFER ID field is set to 00h then the SATL shall return information describing or data read from the sector buffer in the ATA device, depending~~The translation of this field depends on the contents of~~value in~~ the MODE field ~~(see 8.8.2)~~(see 8.8.2). ~~Otherwise, the translation is unspecified (see 3.4.2).~~
BUFFER OFFSET	The translation of this field depends on the contents of the MODE field (see 8.8.2).
ALLOCATION LENGTH	The translation of this field depends on the contents of the MODE field (see 8.8.2).
CONTROL	6.5

The logical sector buffer in a ATA device shall be used to emulate the READ BUFFER command, so the size of the buffer is limited to 512 bytes for data buffer and echo buffers.

8.8.2 MODE field

8.8.2.1 MODE field overview

Table 27 describes values of the MODE field ~~that the SATL shall support~~.

Table 27 — MODE field

Code	Description or reference	Type
02h (i.e., Data mode)	If BUFFER ID field is set to 00h, then the translation shall be to the ATA READ BUFFER command (see 8.8.2.2). Otherwise, the translation is unspecified (see 3.4.2).	M
03h (i.e., Descriptor mode)	8.8.2.3	M
1Ch (i.e., Error history mode)	8.8.2.4	O
All others	Unspecified (see 3.4.2)	
Key: M = Mode implementation is Mandatory O = Mode implementation is Optional		

8.8.2.2 Data mode

The MODE SPECIFIC field is unspecified (see 3.4.2) for Data mode.

If the BUFFER ID field is set to 00h, the BUFFER OFFSET field is set to 00h, and the ALLOCATION LENGTH field is set to 512, then the SATL shall return 512 bytes of data.

If the BUFFER ID field is set to 00h, the BUFFER OFFSET field is set to 00h, and the ALLOCATION LENGTH field is set to a value other than 512, then the SATL shall either:

a) return the lesser of 512 bytes of data or the number of bytes specified in the ALLOCATION LENGTH field from the buffer in the ATA device by sending an ATA READ BUFFER command to the ATA device; or
b) terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN CDB.

If the BUFFER ID field is set to 00h and the BUFFER OFFSET field is set to a value other than 00h then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN CDB.

The SATL may support a value other than 00h in the BUFFER ID field. If the SATL supports a value other than 00h in the BUFFER ID field then the implementation shall be as defined in SPC-4.

A WRITE BUFFER command may be sent to the same buffer ID before it is read with the READ BUFFER command.

8.8.2.3 Descriptor mode

The MODE SPECIFIC field is unspecified (see 3.4.2) for Descriptor mode.

If the ALLOCATION LENGTH field is set to less than four, then the SATL shall return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

If the ALLOCATION LENGTH field is set to four or greater, then the SATL shall return four bytes of data describing the requested buffer, including the OFFSET BOUNDARY field and the BUFFER CAPACITY field.

If the BUFFER ID field is set to zero then the SATL shall return:

a) OFFSET BOUNDARY field set to 9h (i.e., 512 bytes); and
b) BUFFER CAPACITY field set to 200h (i.e., 512 bytes).

The SATL may support a value other than zero in the BUFFER ID field and the implementation is unspecified.

8.8.2.4 Error history mode

8.8.2.4.1 Error history mode overview

This mode is used to manage and retrieve the ATA Current Device Internal Status Data Log or the ATA Saved Device Internal Status Data Log.

If the ATA device does not support:

a) the general purpose logging feature set; or
b) ATA log page 24h and ATA log page 25h,

then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR.

The translation of the BUFFER ID field is described in table 28.

Table 28 — BUFFER_ID field and translation

Code	Translation
00h	The SATL shall return the error history directory as described in 8.8.2.4.2
01h	The SATL shall: 1) create current device internal status data as described in 8.8.2.4.4; and 2) return the error history directory as described in 8.8.2.4.5.
02h	The SATL shall: 1) establish the error history I_T nexus as described in 8.8.2.4.3; and 2) return the error directory as described in 8.8.2.4.2.
03h	The SATL shall: 1) establish the error history I_T nexus as described in 8.8.2.4.3; 2) create current device internal status data as described in 8.8.2.4.4; and 3) return the error history directory as described in 8.8.2.4.2.
10h to EFh	The SATL shall return error history information as described in 8.8.2.4.5 and 8.8.2.4.6.
FEh	The SATL shall clear the error history I_T nexus as described in 8.8.2.4.3.
FFh	The SATL shall: 1) clear the error history I_T nexus as described in 8.8.2.4.3; and 2) release the current device internal status data using an unspecified method.
all others	Unspecified (see 3.4.2)

8.8.2.4.2 Error history directory

To return the error history directory the SATL shall send an ATA read log command to read the ATA General Purpose Log Directory (i.e., ATA GPL Log address 00h) to determine the number of log pages at log address 24h and to determine the number of log pages at log address 25h. If the number of log pages at log address 24h is greater than zero or the number of log pages at log address 25h is greater than zero, then the SATL shall:

1) send an ATA read log command with bit 0 in the Feature field set to zero to read the ATA Current Device Internal Status Data Header page (i.e., ATA GPL Log address 24h, log page 00h);
2) terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR if the ATA read log command in step 1) completes with an error; and
3) if the ATA read log command in step 1) completes without error, return the error history directory with the:
   A) T10 VENDOR IDENTIFICATION field set to:
      a) the eight ASCII characters 'ATA¬¬¬¬¬'; or
      b) an eight byte string identifying the vendor of the SATL;
   B) VERSION field set to a vendor specific value;
   C) EHS_RETRIEVED field set to 00b;
   D) EHS_SOURCE field set to 11b;
   E) CLR_SUP field set to 0b;
   F) DIRECTORY_LENGTH field set to 0000h (i.e., zero error history directory entries) if:
      a) the DEVICE INTERNAL STATUS DATA AREA 3 LAST LOG PAGE field in the ATA current device internal status data header (i.e., log page 00h) returned by the ATA read log command in step 1) is set to zero; and
      b) the SAVED DATA field in the ATA current device internal status data header returned by the ATA read log command in step 1) is set to zero;
   G) DIRECTORY_LENGTH field set to 0008h (i.e., one error history directory entry) if one of the following is true:

a) the DEVICE INTERNAL STATUS DATA AREA 3 LAST LOG PAGE field in the ATA current device internal status data header returned by the ATA read log command in step 1) is set to a non-zero value; or
b) the SAVED DATA field in the ATA current device internal status data header returned by the ATA read log command in step 1) is set to one;

H) DIRECTORY_LENGTH field set to 0010h (i.e., two error history directory entries) if:
a) the DEVICE INTERNAL STATUS DATA AREA 3 LAST LOG PAGE field in the ATA current device internal status data header returned by the ATA read log command in step 1) is set to a non-zero value; and
b) the SAVED DATA field in the ATA current device internal status data header returned by the ATA read log command in step 1) is set to one;

and

I) zero (see F)), one (see G)), or two (see H)) error history directory entries as described in table 29.

Table 29 — Error history directory entry contents

Field name	Current device internal status	Saved device internal status
SUPPORTED BUFFER ID	A value that the application client sends in the BUFFER ID field to cause the SATL to return the contents of the current device internal status data.	A value that the application client sends in the BUFFER ID field to cause the SATL to return the contents of the saved device internal status data.
BUFFER FORMAT	01h	02h
BUFFER SOURCE	3h or 4h [a]	2h
MAXIMUM AVAILABLE LENGTH	512 × ATA GPL Log Address 00h word 24	512 × ATA GPL Log Address 00h word 25

[a] The value 3h shall be returned if the BUFFER ID field that caused the error history directory to be returned was 01h or 03h. The value 4h shall be returned if the BUFFER ID field that caused the error history directory to be returned was not 01h and was not 03h.

8.8.2.4.3 Locking and Unlocking

If the error history I_T nexus is established, the SATL shall process READ BUFFER commands with the MODE field set to 1Ch from only the initiator that established the error history I_T nexus as described in SPC-5.

If the error history I_T nexus is cleared, the SATL shall process READ BUFFER commands with the MODE field set to 1Ch from any initiator as described in SPC-5.

The SATL shall establish error history I_T nexus unit attention conditions as described in SPC-5.

8.8.2.4.4 Create current device internal status log

To create the current device internal status data the SATL shall send an ATA read log command with bit 0 in the Feature field set to one to read the ATA Current Device Internal Status Data pages (i.e., ATA GPL Log address 24h).

8.8.2.4.5 Return current error history buffers

If the BUFFER ID field in the READ BUFFER command (see 8.8) matches the value in the SUPPORTED BUFFER ID field of an error history directory entry (see table 29) with a BUFFER FORMAT field set to 01h, then the SATL shall send an ATA read log command with bit 0 in the Feature field set to zero to read the ATA Current Device Internal Status Data pages (i.e., ATA GPL Log address 24h).

The SATL shall read no more log pages from ATA GPL Log address 24h than indicated by the NUMBER OF LOG PAGES AT LOG ADDRESS 24h field in the ATA General Purpose Log Directory (i.e., GPL log address 00h).

If the ALLOCATION LENGTH field in the READ BUFFER command is not a multiple of 512 (e.g., 512, 2048, 2560, 3072), then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

Table 30 shows the translation of the current device internal status data log.

Table 30 — Current Device Internal Status Data Log translation

Current device internal status parameter data field	ATA Current Device Internal Status Data field
IEEE COMPANY ID	ORGANIZATION IDENTIFIER
CURRENT INTERNAL STATUS DATA SET ONE LENGTH	DEVICE INTERNAL STATUS DATA AREA 1 LAST LOG PAGE
CURRENT INTERNAL STATUS DATA SET TWO LENGTH	DEVICE INTERNAL STATUS DATA AREA 2 LAST LOG PAGE
CURRENT INTERNAL STATUS DATA SET THREE LENGTH	DEVICE INTERNAL STATUS DATA AREA 3 LAST LOG PAGE
SAVED DATA AVAILABLE	SAVED DATA AVAILABLE
SAVED DATA GENERATION NUMBER	SAVED DATA GENERATION NUMBER
CURRENT REASON IDENTIFIER	REASON IDENTIFIER
CURRENT INTERNAL STATUS DATA SET A, CURRENT INTERNAL STATUS DATA SET B, and CURRENT INTERNAL STATUS DATA SET C	If the ATA DEVICE INTERNAL STATUS DATA AREA 3 LAST LOG PAGE field is not set to zero, then the SATL shall transfer starting from ATA GPL Log address 24h log page 01h ending at the log page indicated in the DEVICE INTERNAL STATUS DATA AREA 3 LAST LOG PAGE field. If the ATA DEVICE INTERNAL STATUS DATA AREA 3 LAST LOG PAGE field is set to zero, then no data shall be transferred to these fields.

8.8.2.4.6 Return saved error history buffers

If the BUFFER ID field in the READ BUFFER command (see 8.8) matches the value in the SUPPORTED BUFFER ID field of an error history directory entry (see table 29) with a BUFFER FORMAT field set to 02h, then the SATL shall send an ATA read log command to read the ATA Saved Device Internal Status Data pages (i.e., ATA GPL Log address 25h).

The SATL shall read no more log pages from ATA GPL Log address 25h than indicated by the NUMBER OF LOG PAGES AT LOG ADDRESS 25h field in the ATA General Purpose Log Directory (i.e., GPL log address 00h).

If the ALLOCATION LENGTH field in the READ BUFFER command is not an multiple of 512 (e.g., 512, 2048, 2560, 3072), then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

Table 31 shows the translation of the saved device internal status data log.

Table 31 — Saved Device Internal Status Data Log translation

Saved device internal status parameter data field	ATA Saved Device Internal Status Data field
IEEE COMPANY ID	ORGANIZATION IDENTIFIER
SAVED INTERNAL STATUS DATA SET ONE LENGTH	DEVICE INTERNAL STATUS DATA AREA 1 LAST LOG PAGE
SAVED INTERNAL STATUS DATA SET TWO LENGTH	DEVICE INTERNAL STATUS DATA AREA 2 LAST LOG PAGE
SAVED INTERNAL STATUS DATA SET THREE LENGTH	DEVICE INTERNAL STATUS DATA AREA 3 LAST LOG PAGE
SAVED DATA AVAILABLE	SAVED DATA AVAILABLE
SAVED DATA GENERATION NUMBER	SAVED DATA GENERATION NUMBER
SAVED REASON IDENTIFIER	REASON IDENTIFIER
CURRENT INTERNAL STATUS DATA SET A, CURRENT INTERNAL STATUS DATA SET B, and CURRENT INTERNAL STATUS DATA SET C	If the ATA DEVICE INTERNAL STATUS DATA AREA 3 LAST LOG PAGE field is not set to zero, then the SATL shall transfer starting from ATA GPL Log address 25h log page 01h ending at the log page indicated in the DEVICE INTERNAL STATUS DATA AREA 3 LAST LOG PAGE field. If the ATA DEVICE INTERNAL STATUS DATA AREA 3 LAST LOG PAGE field is set to zero, then no data shall be transferred to these fields.

8.9 REPORT TIMESTAMP command

8.9.1 REPORT TIMESTAMP command overview

The REPORT TIMESTAMP command (see SPC-4) requests that the SATL return the value of the timestamp.

If the Supported bit in the Device Statistics Flags in the ATA Date and Time TimeStamp statistic is set to zero, then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

The SATL shall send an ATA read log command (see 3.1.28) for the ATA general statistics log.

Table 32 shows the translation for the fields in the REPORT TIMESTAMP CDB.

Table 32 — REPORT TIMESTAMP CDB field translations

Field	Description or reference
OPERATION CODE / SERVICE ACTION	Set to A3h/0Fh.
ALLOCATION LENGTH	Unspecified (see 3.4.2).
CONTROL	6.5.

Table 33 shows the translation for the fields in the REPORT TIMESTAMP parameter data buffer.

Table 33 — REPORT TIMESTAMP parameter data buffer translations

REPORT TIMESTAMP parameter data	ATA field	Description
TIMESTAMP PARAMETER DATA LENGTH	n/a	Unspecified (see 3.4.2).
TIMESTAMP ORIGIN	ValidValue bit in the Device Statistics Flags in the Date and Time TimeStamp Statistic.	8.9.2.
TIMESTAMP	The Date and Time TimeStamp field in the Date and Time TimeStamp Statistic.	The timestamp value.

8.9.2 Timestamp origin

If the ValidValue bit in the Device Statistics Flags in the ATA Date and Time TimeStamp statistic is set to one then the TIMESTAMPORIGIN field shall be set to 010b. If the ValidValue bit in the Device Statistics Flags in the ATA Date and Time TimeStamp statistic is set to zero, then the TIMESTAMP ORIGIN field shall be set to 000b.

8.10 REQUEST SENSE command

8.10.1 REQUEST SENSE command overview

The REQUEST SENSE command requests any available sense data to be returned to the application client.

The SATL shall determine if there is contingent allegiance (see SAM-2) sense data to return to the application client. To determine if there is power condition sense data to return, the SATL shall send the ATA CHECK POWER MODE command to the ATA device. If the ATA CHECK POWER MODE command completes with an error, and the device supports the SANITIZE feature set (see ACS-3), then the SATL shall send an ATA SANITIZE STATUS EXT command to determine status of any sanitize operation.

In the event of multiple sense conditions, the SATL shall return sense data in accordance with the precedence specified in SPC-4.

If the SATL has no sense data to return, then the SATL shall complete the REQUEST SENSE command with GOOD status with the sense key set to NO SENSE and the additional sense code set to NO ADDITIONAL SENSE DATA (see SPC-4). The SATL shall return any available sense data to the application client. Table 34 lists examples of conditions where the SATL has sense data to return.

Table 34 — Special REQUEST SENSE behavior reference

Emulated device state	Reference
Format operation in progress	8.10.2
SMART threshold exceeded condition	8.10.3
Stopped power condition	8.10.4

Table 34 — Special REQUEST SENSE behavior reference

Emulated device state	Reference
Unit attention condition established	8.10.5
Idle power condition	8.10.6
Standby power condition	8.10.7
Sanitize operation in progress	8.10.8

Table 35 shows the fields in the REQUEST SENSE CDB.

Table 35 — REQUEST SENSE CDB field translations

Field	Description or reference
OPERATION CODE	Set to 03h.
DESC	Unspecified [a](see 3.4.2).
ALLOCATION LENGTH	Unspecified (see 3.4.2).
CONTROL	6.5

[a] SATLs compliant with previous versions of this standard (see SAT) required that descriptor-mode sense be supported if the SATL supported the ATA PASS-THROUGH command.

8.10.2 Format operation in progress

If the SATL is processing a format operation (see SBC-3) and the SATL receives a REQUEST SENSE command, then the SATL shall provide pollable sense data (see SPC-4) with the sense key set to NOT READY with the additional sense code set to LOGICAL UNIT NOT READY, FORMAT IN PROGRESS. The sense key specific bytes shall be set to progress indication as defined in SBC-3 and SPC-4.

8.10.3 SMART threshold exceeded condition

If:

a) the ATA device has the SMART feature set enabled (i.e., ATA IDENTIFY DEVICE data word 85 bit 0 is set to one);
b) the MRIE field in the Informational Exceptions Control mode page is set to 6h (see 10.1.10.2);
c) the DEXCPT bit in the Informational Exceptions Control mode page is set to zero; and
d) the most recent ATA SMART RETURN STATUS command to the ATA device indicates that the error threshold has been exceeded;

then the SATL shall:

a) return parameter data containing sense data with the sense key set to NO SENSE with the additional sense code set to HARDWARE IMPENDING FAILURE GENERAL HARD DRIVE FAILURE; and
b) complete the REQUEST SENSE command with GOOD status.

8.10.4 Stopped power condition

If the emulated logical unit is in the stopped power condition then the SATL shall provide pollable sense data (see SPC-4) with the sense key set to NOTREADY with the additional sense code set to NO ADDITIONAL SENSE DATA or LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED.

8.10.5 Unit attention condition established

The SATL shall:

1) return parameter data containing sense data describing the unit attention condition (see SPC-4); and
2) complete the REQUEST SENSE command with GOOD status.

8.10.6 Idle power condition

If the emulated logical unit is in the idle power condition (e.g., after returning GOOD status to a START STOP UNIT command with the POWER CONDITION field set to IDLE), then the SATL shall provide pollable sense data (see SPC-4) with the sense key set to NO SENSE with the additional sense code set to:

c) POWER CONDITION CHANGE TO IDLE if the ATA CHECK POWER MODE command indicates Idle state; or
d) IDLE CONDITION ACTIVATED BY COMMAND if the logical unit entered the idle power condition due to a START STOP UNIT command or receipt of a command requiring the idle power condition.

8.10.7 Standby power condition

If the emulated logical unit is in the standby power condition (e.g., after returning GOOD status to a START STOP UNIT command with the POWER CONDITION field set to STANDBY), then the SATL shall provide pollable sense data (see SPC-4) with the sense key set to NO SENSE with the additional sense code set to:

e) POWER CONDITION CHANGE TO STANDBY if the ATA CHECK POWER MODE command indicates Standby state; or
f) STANDBY CONDITION ACTIVATED BY COMMAND if the logical unit entered the standby power condition due to a START STOP UNIT command or receipt of a command requiring the standby power condition.

8.10.8 Sanitize operation in progress

If the SATL is processing a sanitize operation (see SBC-3) and the SATL receives a REQUEST SENSE command, then the SATL shall send an ATA SANITIZE STATUS EXT command to the ATA device to determine the status of the sanitize operation. If the ATA SANITIZE STATUS EXT command output indicates that:

a) the sanitize operation is in progress, then the SATL shall provide pollable sense data (see SPC-4) with the sense key set to NOT READY, the additional sense code set to LOGICAL UNIT NOT READY, SANITIZE IN PROGRESS, and the PROGRESS INDICATION field in the sense key specific bytes set to the value of the ATA Sanitize Progress Indication field; or
b) the sanitize operation completed with error, then the SATL shall provide pollable sense data with the sense key set to MEDIUM ERROR and the additional sense code set to SANITIZE COMMAND FAILED; or
c) the sanitize operation completed without error, then the SATL shall provide sense data with the sense key set to NO SENSE, and the additional sense code set to NO ADDITIONAL SENSE.

8.11 SECURITY PROTOCOL IN command

The SECURITY PROTOCOL IN command provides a means for the application client to retrieve security information from a SCSI target device. The SATL shall send the ATA TRUSTED RECEIVE command or ATA TRUSTED RECEIVE DMA command to the ATA device if the ALLOCATION LENGTH field is non-zero. Otherwise,

the SATL shall send the ATA TRUSTED NON-DATA command to the ATA device.Table 36 shows the translation for fields specified in the SECURITY PROTOCOL IN CDB.

Table 36 — SECURITY PROTOCOL IN CDB field translation

Field	Description or reference
OPERATION CODE	Set to A2h.
SECURITY PROTOCOL	Copy to the ATA SECURITY PROTOCOL field
SECURITY PROTOCOL SPECIFIC	Copy to the ATA SP SPECIFIC field
INC_512	8.11.1
ALLOCATION LENGTH	8.11.1
CONTROL	6.5

8.11.1 ALLOCATION LENGTH field

If the ALLOCATION LENGTH field is set to zero, then the SATL shall use the ATA TRUSTED NON-DATA command with bit 24 of the LBA field set to one, instead of ATA TRUSTED RECEIVE command or ATA TRUSTED RECEIVE DMA command and the INC_512 bit shall be ignored.

If the INC_512 bit is set to one, then if the ALLOCATION LENGTH field contains a value greater than 0000_FFFFh, then the SATL shall return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB. Otherwise, the ATA TRANSFER LENGTH field shall be set to the contents of bits (15:0) of the ALLOCATION LENGTH field. After completion of the ATA TRUSTED RECEIVE command or ATA TRUSTED RECEIVE DMA command without error, the data shall be transferred to the SCSI application client.

If the INC_512 bit is set to zero, then if the ALLOCATION LENGTH field contains a value greater than 01FF_FE00h, then the SATL shall return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB. Otherwise, the ATA TRANSFER LENGTH field shall be translated from a number of bytes to a number of padded 512-byte units from the result of the following calculation:

ATA TRANSFER LENGTH(15:0) = ((allocation length + 511) / 512)

After successful completion of the ATA TRUSTED RECEIVE command or ATA TRUSTED RECEIVE DMA command, the data shall be transferred to the SCSI application client up to the number of bytes specified in the ALLOCATION LENGTH field.

8.12 SECURITY PROTOCOL OUT command

The SECURITY PROTOCOL OUT command provides a means for the application client to send security information to a SCSI target device.The SATL shall send the ATA TRUSTED SEND command or ATA TRUSTED SEND DMA command to the ATA device if the ALLOCATION LENGTH field is non-zero. Otherwise, the SATL shall

send the ATA TRUSTED NON-DATA command to the ATA device. Table 37 shows the translation for fields specified in the SECURITY PROTOCOL OUT CDB.

Table 37 — SECURITY PROTOCOL OUT CDB field translation

Field	Description or Reference
OPERATION CODE	Set to B5h.
SECURITY PROTOCOL	Copy to the ATA SECURITY PROTOCOL field.
SECURITY PROTOCOL SPECIFIC	Copy to the ATA SP SPECIFIC field
INC_512	8.12.1
TRANSFER LENGTH	8.12.1
CONTROL	6.5

8.12.1 TRANSFER LENGTH field

If the TRANSFER LENGTH field is set to zero, then the SATL shall use the ATA TRUSTED NON-DATA command with bit 24 of the LBA field set to zero, instead of the ATA TRUSTED SEND command or ATA TRUSTED SEND DMA command and the INC_512 bit shall be ignored.

If the INC_512 bit is set to one, then if the TRANSFER LENGTH field contains a value greater than 0000_FFFFh, then the SATL shall return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB. Otherwise, the ATA TRANSFER LENGTH field shall be set to the contents of bits (15:0) of the ALLOCATION LENGTH field. The ATA TRUSTED SEND command or ATA TRUSTED SEND DMA command shall be used to transfer the data.

If the INC_512 bit is set to zero, then if the TRANSFER LENGTH field contains a value greater than 01FF_FE00h, then the SATL shall return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB. Otherwise, the ATA TRANSFER LENGTH field shall be translated from a number of bytes to a number of padded 512-byte units from the result of the following calculation:

ATA TRANSFER LENGTH(15:0) = ((transfer length + 511) / 512)

The final data block may be padded (see SPC-4). The ATA TRUSTED SEND command or ATA TRUSTED SEND DMA command shall transfer the padded data for the number of blocks specified by the ATA TRANSFER LENGTH field.

8.13 SEND DIAGNOSTIC command

8.13.1 SEND DIAGNOSTIC command overview

The SEND DIAGNOSTIC command provides a mechanism for an application client to request diagnostic operations to be performed on the target device, logical unit, or both. The SATL shall implement the default

self-test feature (see SPC-4). Table 38 shows the translation for fields specified in the SEND DIAGNOSTIC CDB.

Table 38 — SEND DIAGNOSTIC CDB field translations

Field	Description or reference
OPERATION CODE	Set to 1Dh. See 8.13.2.
SELF-TEST CODE	8.13.2 and 8.13.3.
PF	Unspecified (see 3.4.2).
SELFTEST	8.13.3
DEVOFFL	If the DEVOFFL bit is set to zero, then the SATL shall process the command as specified in SPC-4. If the DEVOFFL bit is set to one, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.
UNITOFFL	If the UNITOFFL bit is set to zero, then the SATL shall process the command as specified in SPC-4. If the UNITOFFL bit is set to one, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.
PARAMETER LIST LENGTH	If the PARAMETER LIST LENGTH field is set to zero, then the SATL shall process the command as specified in SPC-4. If the PARAMETER LIST LENGTH field is not set to zero, then the SATL shall terminate the command with a CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB.
CONTROL	6.5

8.13.2 SELF-TEST CODE field

The SATL shall determine if the value in the SELF-TEST CODE field is valid depending on the value of the SELFTEST bit and the information that is reported by the ATA device with respect to the ATA SMART EXECUTE OFF-LINE IMMEDIATE command (see 8.13.3).

If the value of the SELF-TEST CODE field is valid, then the SATL shall process the command as described in table 39.

Table 39 — SELF-TEST CODE field translation (part 1 of 2)

Code	**Name of test**	**Description of test**
000b	Default self-test	Used if the SELFTEST bit is set to one.
001b	Background short self-test	The SATL shall perform the following: 1) return status for the SEND DIAGNOSTIC command as soon as the CDB has been validated and initialize the Self-Test Results log page (see 10.2.5 and SPC-4); and 2) send an ATA SMART EXECUTE OFF-LINE IMMEDIATE command with bits 7:0 of the ATA LBA field set to 1 (i.e., Execute SMART Short self-test routine immediately in off-line mode) to the ATA device.
010b	Background extended self-test	The SATL shall perform the following: 1) return status for the SEND DIAGNOSTIC command as soon as the CDB has been validated and initialize the Self-Test Results log page (see 10.2.5 and SPC-4); and 2) send an ATA SMART EXECUTE OFF-LINE IMMEDIATE command with bits 7:0 of the ATA LBA field set to 2 (i.e., Execute SMART Extended self-test routine immediately in off-line mode) to the ATA device.
011b	Reserved	
100b	Abort background self-test	If a previous SEND DIAGNOSTIC command specified a background self-test function and that self-test has not completed (see SPC-4), then the SATL shall send an ATA SMART EXECUTE OFF-LINE IMMEDIATE command with bits 7:0 of the ATA LBA field set to 127 (i.e., Abort off-line mode self-test routine) to the ATA device. If the ATA SMART EXECUTE OFF-LINE IMMEDIATE command completes without error, then the SATL shall return GOOD status. If the ATA command completes with an error, then the SATL shall respond as defined in SPC-4.

Table 39 — SELF-TEST CODE field translation (part 2 of 2)

Code	Name of test	Description of test
101b	Foreground short self-test	The SATL shall send an ATA SMART EXECUTE OFF-LINE IMMEDIATE command with bits 7:0 of the ATA LBA field set to 129 (i.e., Execute SMART Short self-test routine immediately in captive mode) to the ATA device. If the ATA SMART EXECUTE OFF-LINE IMMEDIATE command completes without error, then the SATL shall update the Self-Test Results log page prior to returning GOOD status. If the ATA command completes with an error, then the SATL shall first update the Self-Test Results log page (i.e., if supported, see SPC-4), and terminate the command with CHECK CONDITION status with the sense key set to HARDWARE ERROR and the additional sense code set to LOGICAL UNIT FAILED SELF-TEST.
110b	Foreground extended self-test	The SATL shall send an ATA SMART EXECUTE OFF-LINE IMMEDIATE command with bits 7:0 of the ATA LBA field set to 130 (i.e., Execute SMART Extended self-test routine immediately in captive mode) to the ATA device. If the ATA SMART EXECUTE OFF-LINE IMMEDIATE command completes without error, then the SATL shall update the Self-Test Results log page prior to returning GOOD status. If the ATA command completes with an error, then the SATL shall first update the Self-Test Results log page (i.e., if supported, see SPC-4), and then terminate the command with CHECK CONDITION status with the sense key set to HARDWARE ERROR and additional sense code set to LOGICAL UNIT FAILED SELF-TEST.
111b	Reserved	

8.13.3 SELFTEST bit

The SATL shall translate the SELFTEST bit according to whether or not the ATA device supports and has enabled the ATA SMART EXECUTE OFF-LINE IMMEDIATE command as shown in table 40.

Table 40 — SELFTEST bit

Code	ATA SMART EXECUTE OFF-LINE IMMEDIATE command [a]		SATL translation
	supported	enabled	
0	no	n/a	The SATL shall terminate the SEND DIAGNOSTIC command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.
	yes	no	The SATL shall terminate the SEND DIAGNOSTIC command with CHECK CONDITION status with the sense key set to ABORTED COMMAND and the additional sense code set to ATA DEVICE FEATURE NOT ENABLED.
		yes	If the SELF-TEST CODE field is valid, then the SATL shall process the SEND DIAGNOSTIC command according to the value specified in the SELF-TEST CODE field as defined in 8.13.2.

[a] The SATL shall determine if the ATA SMART EXECUTE OFF-LINE IMMEDIATE command is supported and enabled based on the ATA IDENTIFY DEVICE data log SMART SELF-TEST SUPPORTED bit and SMART ENABLED bit (see ACS-3).

[b] The SATL may retry any of the three ATA Verify commands if an ATA Verify command fails on the first attempt, and the retried command may specify an alternate LBA. If the retried command completes without error, then the SATL may consider the ATA Verify command as having completed without error.

Table 40 — SELFTEST bit

Code	ATA SMART EXECUTE OFF-LINE IMMEDIATE command [a]		SATL translation
	supported	enabled	
1	no	n/a	The SATL shall send three ATA verify commands (see 3.1.33) to the ATA device with the ATA COUNT field set to one and the ATA LBA field set to: a) zero; b) the maximum user-addressable LBA; and c) an arbitrary number between zero and the maximum user-addressable LBA. If any of the three ATA verify commands ends with an error, then the SATL shall terminate the SEND DIAGNOSTIC command with a CHECK CONDITION status with the sense key set to HARDWARE ERROR and the additional sense code set to LOGICAL UNIT FAILED SELF-TEST. If all three ATA verify commands complete without error [b], then the SATL shall return GOOD status.
	yes	no	
	yes		The SATL shall send an ATA SMART EXECUTE OFF-LINE IMMEDIATE command with bits 7:0 of the ATA LBA field set to 129 (i.e., Execute SMART Short self-test routine immediately in captive mode) to the ATA device. If the ATA EXECUTE OFF-LINE IMMEDIATE command completes without error, then the SATL shall return GOOD status. If the ATA EXECUTE OFF-LINE IMMEDIATE command completes with an error, then the SATL shall terminate the SEND DIAGNOSTIC command with a CHECK CONDITION status with the sense key set to HARDWARE ERROR and the additional sense code set to LOGICAL UNIT FAILED SELF-TEST.

[a] The SATL shall determine if the ATA SMART EXECUTE OFF-LINE IMMEDIATE command is supported and enabled based on the ATA IDENTIFY DEVICE data log SMART SELF-TEST SUPPORTED bit and SMART ENABLED bit (see ACS-3).

[b] The SATL may retry any of the three ATA Verify commands if an ATA Verify command fails on the first attempt, and the retried command may specify an alternate LBA. If the retried command completes without error, then the SATL may consider the ATA Verify command as having completed without error.

8.14 SET TIMESTAMP command

8.14.1 SET TIMESTAMP command overview

The SET TIMESTAMP command (see SPC-4) requests that the SATL initialize the timestamp.

If the SUPPORTED bit in the Device Statistics Flags in the ATA Date and Time TimeStamp statistic is set to zero, then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

The SATL shall send an ATA SET DATE & TIME EXT command.

Table 41 shows the translation for fields in the SET TIMESTAMP CDB.

Table 41 — SET TIMESTAMP CDB field translations

Field	Description or Reference
OPERATION CODE / SERVICE ACTION	Set to A4h/0Fh.
PARAMETER LIST LENGTH	Unspecified (see 3.4.2).
CONTROL	6.5

Table 42 shows the translation for the fields in the SET TIMESTAMP parameter data buffer.

Table 42 — SET TIMESTAMP parameter buffer translation

Data-out Buffer field	ATA field	Description or reference
TIMESTAMP	ATA LBA field	The timestamp value

8.15 TEST UNIT READY command

8.15.1 TEST UNIT READY command overview

The TEST UNIT READY command is used to determine whether the device is ready (see table 43).

Table 43 — TEST UNIT READY CDB field translations

Field	Description or reference
OPERATION CODE	Set to 00h. See 8.15.2.
CONTROL	6.5

8.15.2 TEST UNIT READY command translation

The SATL processes the TEST UNIT READY command as follows:

1) If any condition exists that prevents the SATL from issuing commands to the ATA device, then the SATL should terminate the TEST UNIT READY command with CHECK CONDITION status with the sense key set to NOT READY with the additional sense code of LOGICAL UNIT NOT READY, CAUSE NOT REPORTABLE;
2) If the device is in the stopped power condition as the result of processing a START STOP UNIT command (see 9.16), then the SATL shall terminate the TEST UNIT READY command with CHECK CONDITION status with the sense key set to NOT READY and the additional sense code of LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED;
3) If the ATA device is processing a self-test in the foreground mode, then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT READY, SELF-TEST IN PROGRESS;
4) If the SATL is processing a FORMAT UNIT command for the emulated device (see 9.4), then the SATL shall terminate the TEST UNIT READY command with CHECK CONDITION status with the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT NOT READY, FORMAT IN PROGRESS;

5) if the SATL is processing a SANITIZE command for the emulated device (see 9.4), then the SATL shall terminate the TEST UNIT READY command with CHECK CONDITION status with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT READY, SANITIZE IN PROGRESS;
6) If the ATA device completed the most recent ATA command with the DF bit set to one in the STATUS field, then the SATL shall terminate the TEST UNIT READY command with CHECK CONDITION status with the sense key set to HARDWARE ERROR and the additional sense code of LOGICAL UNIT FAILURE or INTERNAL TARGET FAILURE.

If none of the conditions defined in items 1 through 6 apply, then the SATL shall send an ATA CHECK POWER MODE command to the ATA device, and:

a) If the ATA CHECK POWER MODE command completes without error, then the SATL shall complete the TEST UNIT READY command with GOOD status; or
b) if the ATA CHECK POWER MODE command completes with the DF bit set to 1 in the STATUS field, the SATL shall terminate the TEST UNIT READY command with CHECK CONDITION status with the sense key set to HARDWARE ERROR and the additional sense code of LOGICAL UNIT FAILURE or INTERNAL TARGET FAILURE.
c) if the ATA CHECK POWER MODE command completes with any other error,, then the SATL shall send an ATA SANITIZE STATUS EXT command to the ATA device and:
   A) if the ATA SANITIZE STATUS EXT command completes without error and the output indicates that a sanitize operation is in progress, then the SATL shall return CHECK CONDITION status with the sense key set to NOT READY, the additional sense code set to LOGICAL UNIT NOT READY, SANITIZE IN PROGRESS, and the PROGRESS INDICATION field in the sense key specific bytes set to the value of the ATA SANITIZE PROGRESS INDICATION field;
   B) if the ATA SANITIZE STATUS EXT command completes without error and the output indicates that the sanitize operation completed with error, then the SATL shall return CHECK CONDITION status with the sense key set to MEDIUM ERROR and the additional sense code set to SANITIZE COMMAND FAILED;
   C) if the ATA SANITIZE STATUS EXT command completes without error and the output indicates that the sanitize operation completed successfully, then the SATL shall complete the TEST UNIT READY command with GOOD status; or
   D) if the ATA SANITIZE STATUS EXT command completes with an error, then the SATL shall terminate the TEST UNIT READY command with CHECK CONDITION status with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT DOES NOT RESPOND TO SELECTION.

8.16 WRITE BUFFER command

8.16.1 WRITE BUFFER command overview

The WRITE BUFFER command (see SPC-4) is used in conjunction with the READ BUFFER command as a diagnostic function for testing logical unit memory in the SCSI target device and the integrity of a service delivery subsystem. An additional mode is provided for downloading and saving microcode.

Table 44 shows the translation for fields specified in the WRITE BUFFER CDB.

Table 44 — WRITE BUFFER CDB field translations

Field	Description or reference
OPERATION CODE	Set to 3Bh.
MODE SPECIFIC	8.16.2.1
MODE	8.16.2.1
BUFFER ID	If the MODE field is set to 02h then see 8.16.2.2; otherwise this field is unspecified (see 3.4.2).
BUFFER OFFSET	8.16.2.1
PARAMETER LIST LENGTH	8.16.2.1
CONTROL	6.5

8.16.2 WRITE BUFFER command translation

8.16.2.1 MODE field

The MODE field specifies the function to be performed by the SATL.

Table 45 — MODE field

Code	Description or reference
02h (i.e., Write data)	Translated to the ATA WRITE BUFFER command (see 8.16.2.2).
05h (i.e., Download microcode and save)	Translated to an ATA download microcode command (see 3.1.12). The ATA FEATURE field shall be set to 07h (i.e., indicating downloaded microcode is saved for immediate and future use) (see 8.16.2.3).
07h (i.e., Download microcode with offsets, save, and activate)	Translated to an ATA download microcode command (see 3.1.12). The ATA FEATURE field shall be set to 03h (i.e., download microcode with offsets is saved for immediate and future use) (see 8.16.2.4).

Table 45 — MODE field

Code	Description or reference
0Dh (i.e., Download microcode with offsets, select activation events, save, and defer active)	Translated to an ATA download microcode command (see 3.1.12). The ATA FEATURE field shall be set to 0Eh (i.e., download microcode with offsets is saved with deferred activation) (see 8.16.2.5).
0Eh (i.e., Download microcode with offsets, save, and defer active)	Translated to an ATA download microcode command (see 3.1.12). The ATA FEATURE field shall be set to 0Eh (i.e., download microcode with offsets is saved with deferred activation) (see 8.16.2.5).
0Fh (i.e., Activate deferred microcode)	Translated to an ATA download microcode command (see 3.1.12). The ATA FEATURE field shall be set to 0Fh (i.e., activate deferred microcode) (see 8.16.2.6).
All others	Unspecified (see 3.4.2).

8.16.2.2 Write data mode 02h

In this mode, data transferred to the SATL from the application client is transmitted to the ATA device using the ATA WRITE BUFFER command.

In this mode, the MODE SPECIFIC field is reserved.

If:

a) the BUFFER ID field is set to 00h;
b) the BUFFER OFFSET field is set to 00h; and
c) the PARAMETER LIST LENGTH field is set to 512,

then the SATL shall write the specified number of bytes to the buffer in the ATA device by sending an ATA WRITE BUFFER command to the ATA device.

If the BUFFER ID FIELD is set to 00h and either:

a) the BUFFER OFFSET field is set to a value other than 00h; or
b) the PARAMETER LIST LENGTH field is set to a value other than 512,

then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN CDB.

The SATL may support a value other than 00h in the BUFFER ID field. If the SATL supports a value other than 00h in the BUFFER ID field, then the implementation shall be as defined in SPC-4.

8.16.2.3 Download microcode mode 05h

In this mode, data transferred to the SATL from the application client is transmitted to the ATA device using the ATA DOWNLOAD MICROCODE command or the ATA DOWNLOAD MICROCODE DMA command if supported by the ATA device (i.e., ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE SUPPORTED bit is set to one or ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE DMA SUPPORTED bit is set to one).

In this mode, the MODE SPECIFIC field is reserved.

If the ATA device does not support either the ATA DOWNLOAD MICROCODE command or the ATA DOWNLOAD MICROCODE DMA command, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN CDB.

If the SATL receives a WRITE BUFFER command with the MODE field set to 05h, the SATL shall send an ATA DOWNLOAD MICROCODE command or an ATA DOWNLOAD MICROCODE DMA command with the ATA fields set as specified in table 46 to the ATA device. . The SATL shall check if the ATA download microcode command completed with an error (see ACS-3). The ATA download microcode command may complete with an error before or after the data transfer is performed. If the ATA download microcode command completed with an error, then the SATL shall terminate the command with CHECK CONDITION status with the sense key and additional sense code set to values as described in clause 11.

Otherwise, the SATL shall:

1) transfer the microcode image or control information from the application client to the ATA device;
2) complete the WRITE BUFFER command with GOOD status; and
3) establish a unit attention condition (see 5.3) for the initiator port associated with all I_T nexuses except the I_T nexus on which the WRITE BUFFER command was received, with the additional sense code set to MICROCODE HAS BEEN CHANGED.

Table 46 — Download microcode mode 05h ATA field values

ATA Field		Contents
Field Name	**Bits**	
FEATURE	7:0	07h
LBA	27:24	Reserved
	23	0b
	22:8	Reserved
	7	0b
	6:0	PARAMETER LIST LENGTH field bits 23:17
COUNT	7:0	PARAMETER LIST LENGTH field bits 16:9

8.16.2.4 Download microcode mode 07h

In this mode, data transferred to the SATL from the application client is transmitted to the ATA device using the ATA DOWNLOAD MICROCODE command or the ATA DOWNLOAD MICROCODE DMA command if supported by the ATA device (i.e., ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE SUPPORTED bit is set to one or ATA IDENTIFY DEVICE datalog DOWNLOAD MICROCODE DMA SUPPORTED bit is set to one).

In this mode, the MODE SPECIFIC field is reserved.

If the ATA device does not support either the ATA DOWNLOAD MICROCODE with offsets and save microcode command for immediate and future use command (e.g., the DOWNLOAD MICROCODE MODE 3 SUPPORTED bit of the DOWNLOAD MICROCODE Capabilities field of ATA Identify Device Data log page 03h is set to zero), then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN CDB.

If the SATL receives a WRITE BUFFER command with the MODE field set to 07h, the SATL shall send an ATA download microcode command (see 3.1.12) with the ATA field values specified in table 47.The SATL shall transfer the microcode or control information from the application client to the ATA device. The SATL shall check if the ATA download microcode command completed with an error. The ATA download microcode command may complete with an error before or after the data transfer is performed. If the ATA download microcode command completed with an error, then the SATL shall terminate the command with CHECK CONDITION status with the sense key and additional sense code set as described in clause 11.

If the contents of both the ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE MAXIMUM TRANSFER SIZE field and ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE MINIMUM TRANSFER SIZE field are non-zero and not FFFFh and the ATA COUNT field returned is value 02h (i.e. indicates that the ATA device has applied the new microcode), then the SATL shall establish a unit attention condition (see SAM-5) for the initiator port associated with all I_T nexuses except the I_T nexus on which the set of WRITE BUFFER commands was received, with the additional sense code set to MICROCODE HAS BEEN CHANGED and then complete the WRITE BUFFER command with GOOD status.

If the ATA DOWNLOAD MICROCODE command or the ATA DOWNLOAD MICROCODE DMA command completes without error, then the SATL shall establish a unit attention condition (see 5.3) for the initiator port associated with all I_T nexuses except the I_T nexus on which the set of WRITE BUFFER commands was received, with the additional sense code set to MICROCODE HAS BEEN CHANGED.

Table 47 — Download microcode mode 07h ATA field values

ATA field		Contents
Field name	**Bits**	
FEATUR	7:0	03h
LBA	27:24	Restricted
	23	0b
	22:8	BUFFER OFFSET field bits 23:9
	7	0b
	6:0	PARAMETER LIST LENGTH field bits 23:17
COUNT	7:0	PARAMETER LIST LENGTH field bits 16:9

If the PARAMETER LIST LENGTH field bits 8:0 is a non-zero value, then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If the BUFFER OFFSET field bits 8:0 is a non-zero value, then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If the PARAMETER LIST LENGTH field bits 23:9 is greater than the contents of ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE MAXIMUM TRANSFER SIZE field, and the contents of ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE MAXIMUM TRANSFER SIZE field is a non-zero value, then the SATL shall either translate the transfer into multiple ATA download microcode commands or terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If the PARAMETER LIST LENGTH field bits 23:9 is less than the contents of the ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE MINIMUM TRANSFER SIZE field, and the contents of the ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE MINIMUM TRANSFER SIZE field is not an FFFFh value, then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB

The SATL may translate a single WRITE BUFFER mode 07h request into multiple ATA download microcode commands.

8.16.2.5 Download microcode mode 0Dh and mode 0Eh

In these modes, data transferred to the SATL from the application client is transmitted to the ATA device using an ATA download microcode command(see 3.1.12) if supported by the ATA device (i.e., ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE SUPPORTED bit is set to one or ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE DMA SUPPORTED bit is set to one).

The MODE SPECIFIC field is reserved for mode 0Eh.

If the ATA device does not support the ATA DOWNLOAD MICROCODE with offsets and save microcode for future use command (i.e., the DOWNLOAD MICROCODE OFFSETS DEFERRED SUPPORTED bit of the DOWNLOAD MICROCODE Capabilities field of ATA Identify Device Data log page 03h is set to zero), then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN CDB.

If the download microcode mode is set to 0Dh and:

a) the PO_ACT bit is set to zero; or
b) the HR_ACT bit is set to one;

then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN CDB.

If the SATL receives a WRITE BUFFER command with the mode field set to 0Dh or 0Eh, the SATL shall send an ATA download microcode command with the ATA field values specified in table 48.. The SATL shall transfer the microcode or control information from the application client to the ATA device. The SATL shall check if the ATA download microcode command completed with an error. The ATA download microcode command may complete with an error before or after the data transfer is performed. If the ATA download microcode command completed with an error, then the SATL shall terminate the command with CHECK CONDITION status with the sense key and additional sense code set as described in clause 11.

Table 48 — Download microcode mode 0Dh and mode 0Eh ATA field values

ATA field		Contents
Field Name	Bits	
FEATURE	7:0	0Eh
LBA	27:24	Reserved
	23	0b
	22:8	BUFFER OFFSET field bits 23:9
	7	0b
	6:0	PARAMETER LIST LENGTH field bits 23:17
COUNT	7:0	PARAMETER LIST LENGTH field bits 16:9

If the PARAMETER LIST LENGTH field bits 8:0 is a non-zero value, then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If the BUFFER OFFSET field bits 8:0 is a non-zero value, then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If the PARAMETER LIST LENGTH field bits 23:9 is greater than the contents of the ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE MAXIMUM TRANSFER SIZE field, and the contents of ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE MAXIMUM TRANSFER SIZE field is a non-zero value, then the SATL shall terminate the

command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If the PARAMETER LIST LENGTH field bits 23:9 is less than the contents of the ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE MINIMUM TRANSFER SIZE field, and the contents of ATA IDENTIFY DEVICE data log DOWNLOAD MICROCODE MINIMUM TRANSFER SIZE field is not a FFFFh value, then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB

The SATL may translate a single WRITE BUFFER mode 0Eh request into multiple ATA download microcode commands.

If the ATA command completes with an error, the SATL shall terminate processing of the SCSI command and report the error as described in clause 11.

If the ATA command completes without error and the ATA device returns a COUNT field set to 01h, then the SATL should send additional ATA download microcode commands.

If the ATA command completes without error and the ATA device returns a COUNT field set to 03h, then the SATL shall remember that the new microcode shall be activated by whichever event in table 49 occurs first.

Table 49 — Activation events for download microcode modes 0Dh and 0Eh

SATL activation events	Microcode to be activated
the next time that the ATA device processes a power-on reset	Deferred microcode shall be activated (see 5.3).
process a WRITE BUFFER command with the mode field set to 0Fh	Deferred microcode shall be activated (see 5.3).
START/STOP UNIT command	Unspecified (see 3.4.2)
FORMAT UNIT command	Unspecified (see 3.4.2)
hard reset	Unspecified (see 3.4.2)
vendor specific event	Unspecified (see 3.4.2)

8.16.2.6 Download microcode mode 0Fh

In this mode, no data is transferred to the SATL from the application client, and no data is transmitted to the ATA device using the ATA download microcode command.

If all of these fields:

a) MODE SPECIFIC;
b) BUFFER OFFSET;
c) BUFFER ID; and
D) PARAMETER LIST LENGTH

are not set to zero, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN CDB.

If the ATA device does not support the ATA DOWNLOAD MICROCODE activate command (i.e., the DOWNLOAD MICROCODE OFFSETS DEFERRED SUPPORTED bit of the DOWNLOAD MICROCODE Capabilities field of ATA Identify Device Data log page 03h is set to zero), then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN CDB.

If the SATL receives a WRITE BUFFER command with the MODE field set to 0Fh, the SATL shall send an ATA download microcode command with the ATA field values specified in table 50. The SATL shall check if the ATA

download microcode command completed with an error. If the ATA download microcode command completed with an error, then the SATL shall terminate the command with CHECK CONDITION status with the sense key and additional sense code set as described in clause 11.

Table 50 — Download Microcode Mode 0Fh ATA Field Values

ATA field		Contents
Field Name	Bits	
FEATURE	7:0	0Fh
LBA	27:24	Reserved
	23	0b
	22:8	Reserved
	7	0b
	6:0	Reserved
COUNT	7:0	Reserved

If the ATA download microcode command completed without error and the value of the Count field in the normal returns is 02h, then the SATL shall establish a unit attention condition (see 5.3) for the initiator port associated with all I_T nexuses except the I_T nexus on which the set of WRITE BUFFER commands was received, with the additional sense code set to MICROCODE HAS BEEN CHANGED.

The SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB if:

a) the ATA LBA field is a non-zero value; or
b) the ATA COUNT field is a non-zero value.

9 SCSI Block Commands (SBC) command mapping

9.1 Translating LBA and transfer length and ATA command use constraints

9.1.1 Overview

A SATL may implement

3) a direct logical block mapping of ATA logical sectors to SCSI logical blocks (see 9.1.2),
4) an indirect logical block mapping translation (see 9.1.3).

9.1.2 Direct logical block mapping model

If the SATL implements direct logical block mapping then the logical block size indicated by the BLOCK LENGTH IN BYTES field in the READ CAPACITY data (see 9.10.2 and 9.11.2) shall equal the ATA logical sector size (see 3.1.19). The ATA LBA of an ATA logical sector shall equal the LBA of the corresponding SCSI logical block.

9.1.3 Indirect logical block mapping model

If the SATL implements indirect block mapping (see 3.1.49), then the constraints of the direct logical block mapping model (see clause 9.1.2) do not apply. The logical block size indicated by the BLOCK LENGTH IN BYTES field in the READ CAPACITY data (see 9.10.2 and 9.11.2) may not equal the ATA logical sector size (see 3.1.19) (e.g., SCSI logical block size of 520 bytes with an ATA Logical Sector Size of 512 bytes). The SATL translates between the SCSI LBA and the ATA LBA in a vendor-specific manner. The result of a logical block address translated in one direction and then translated in the reverse direction shall yield the original LBA.

9.1.4 Selection of ATA block commands

The ATA commands the SATL uses to implement the functions specified by SCSI block commands depend upon:

a) the value of the LOGICAL BLOCK ADDRESS field and TRANSFER LENGTH field specified in the SCSI CDB; and
b) the capabilities of the ATA device and the ATA host within the SATL.

Table 51 relates selection conditions to allowable ATA commands used to implement SCSI block storage data transfer commands. ATA commands listed in the Allowed ATA commands column shall not be used in the translation of a SCSI block command if the prerequisite conditions listed in Selection Prerequisites columns are not met (i.e., the word 'yes' in a Selection Prerequisites column means the prerequisite shall be met before the SATL may use an ATA command listed in that row, and the word 'no' indicates the prerequisite need not be met

for the SATL to use the ATA command listed).

Table 51 — ATA commands used for SCSI block command translations

Selection Prerequisites				Allowed ATA commands
Requires that the highest ATA logical sector accessed is < 2^{28} [a]	ATA feature sets required to be supported and enabled [d]			
	48-bit Address Feature Set[b]	DMA Capability [c]	NCQ Feature Set	
no	no	no	no	FLUSH CACHE WRITE UNCORRECTABLE EXT DATA SET MANAGEMENT
yes	no	no	no	READ MULTIPLE READ SECTOR(S) READ VERIFY SECTOR(S) WRITE MULTIPLE WRITE SECTOR(S) FLUSH CACHE EXT
yes	no	yes	no	READ DMA WRITE DMA
no	yes	yes	no	READ DMA EXT WRITE DMA EXT WRITE DMA FUA EXT
no	yes	no	no	READ MULTIPLE EXT READ SECTOR(S) EXT READ VERIFY SECTOR(S) EXT WRITE MULTIPLE EXT WRITE MULTIPLE FUA EXT WRITE SECTOR(S) EXT
no	no	no	yes	READ FPDMA QUEUED WRITE FPDMA QUEUED

[a] If the SATL implements the direct mapping model (see 9.1.2) between ATA logical sectors and SCSI logical blocks, then this represents the last logical block transferred. If the SATL implements the indirect logical block mapping model, then this constraint is vendor-specific.

[b] If the ATA device supports neither the 48-bit Address feature set (i.e., ATA IDENTIFY DEVICE data log48-BIT SUPPORTED bit is set to zero) nor NCQ (i.e., ATA IDENTIFY DEVICE data log NCQ FEATURE SET SUPPORTED bit is set to 0)(see SATA-3.1) and the LBA of the logical sector is greater than (2^{28}-1), then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the sense code set to LOGICAL BLOCK ADDRESS OUT OF RANGE.

[c] The DMA prerequisite requires both the ATA host in the SATL and the ATA device to have the same DMA transfer mode enabled (i.e., ATA IDENTIFY DEVICE data word 49 bit 8 is set to one and at least one DMA mode is enabled in the ATA IDENTIFY DEVICE data word 63 or word 88).

[d] See ACS-3.

[e] The SATL may transfer the number of logical blocks requested in the TRANSFER LENGTH field of the SCSI CDB by sending multiple ATA commands, each time incrementing the ATA LBA by the ATA SECTOR COUNT transferred.

The SATL may use the ATA commands listed in table 51 in the translation of SCSI read commands (see 3.1.83),

SCSI write commands (see 3.1.87), SCSI write and verify commands (see 3.1.88), SCSI verify commands (see 3.1.86), and SCSI synchronize cache commands (see 3.1.84) if the prerequisites defined for the command as shown in table 51 are satisfied. The translations for specific SCSI block commands in clause 9 further constrain the use of the available ATA commands in implementing the translation.

9.2 CLOSE ZONE command

9.2.1 CLOSE ZONE command overview

The CLOSE ZONE command closes the zone or zones identified by the ZONE ID and ALL fields of the CDB. This command is applicable to ATA host aware zoned devices (see 3.1.16) and ATA host managed zoned devices (see 3.1.17). Table 52 shows the translation for fields in the CLOSE ZONE CDB.

Table 52 — CLOSE ZONE CDB field translations

Field	Description or reference
OPERATION CODE	Set to 94h.
SERVICE ACTION	Set to 01h
ZONE ID	If the SATL implements direct logical block mapping (see 3.1.42), then the SATL shall set the ZONE ID field in the ATA CLOSE ZONE EXT command equal to the value specified in the ZONE_ID field. Otherwise, the mapping is unspecified (see 3.4.2).
ALL	9.2.2
CONTROL	6.5

9.2.2 CLOSE ZONE command processing

The SATL shall issue an ATA CLOSE ZONE EXT command (see ZAC).

If the SATL implements direct logical block mapping, and if the ALL bit is set to zero, the zone to be closed is identified by the ZONE ID field in the CDB. If the SATL does not implement direct logical block mapping, and if the ALL bit is set to zero, identification of the zone to be closed is unspecified.

If the ALL bit is set to one, the SATL shall issue the ATA CLOSE ZONE EXT command with the CLOSE_ALL bit set to one. The ZONE_ID field is ignored.

9.3 FINISH ZONE command

9.3.1 FINISH ZONE command overview

The FINSH ZONE command finishes the zone or zones identified by the ZONE ID and ALL fields of the CDB. This command is applicable to ATA host aware zoned devices (see 3.1.16) and ATA host managed zoned devices (see 3.1.17). Table 53 shows the translation for fields in the FINISH ZONE CDB.

Table 53 — FINISH ZONE CDB field translations

Field	Description or reference
OPERATION CODE	Set to 94h.
SERVICE ACTION	Set to 02h
ZONE ID	If the SATL implements direct logical block mapping (see 3.1.42), then the SATL shall set the ZONE ID field in the ATA FINISH ZONE EXT command equal to the value specified in the ZONE ID field. Otherwise, the mapping is unspecified (see 3.4.2).
ALL	9.3.2
CONTROL	6.5

9.3.2 FINISH ZONE command processing

The SATL shall issue an ATA FINISH ZONE EXT command (see ZAC).

If the SATL implements direct logical block mapping, and if the ALL bit is set to zero, the zone to be finished is identified by the ZONE ID field in the CDB. If the SATL does not implement direct logical block mapping, and if the ALL bit is set to zero, identification of the zone to be finished is unspecified.

If the ALL bit is set to one, the SATL shall issue the ATA FINISH ZONE EXT command with the FINISH_ALL BIT set to one. The ZONE_ID field is ignored.

9.4 FORMAT UNIT command

9.4.1 FORMAT UNIT command overview

The FORMAT UNIT command verifies that all LBAs accessible to SCSI application clients are formatted and ready for data transfers. Table 54 shows the translation for fields in the FORMAT UNIT CDB.

Table 54 — FORMAT UNIT CDB field translations

Field	Description or reference
OPERATION CODE	Set to 04h.
FMTPINFO	Unspecified (see 3.4.2)
LONGLIST	Unspecified (see 3.4.2)
FMTDATA	If set to zero then no data shall be transferred from the application client and if no other illegal fields in the CDB are detected, then the SATL shall return GOOD status without issuing any commands to the ATA device. If set to one then the FORMAT UNIT parameter list shall be transferred from the application client and the SATL shall process the FORMAT UNIT parameter list as described in 9.4.2.
CMPLIST	If a complete list is specified (i.e., the FMTDATA bit is set to one, and the CMPLIST bit is set to one), then the SATL shall terminate the command with a CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB.
DEFECT LIST FORMAT	If: a) the FMTDATA bit is set to 1; b) the DEFECT LIST FORMAT field is set to 000b or 110b; and c) the defect list length is non-zero, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST. If: a) the FMTDATA bit is set to 1; and b) the DEFECT LIST FORMAT field is set to a value other than 000b or 110b, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.
CONTROL	6.5

The SATL shall process commands received during the processing of the FORMAT UNIT command as specified in SBC-3.

9.4.2 FORMAT UNIT parameter list

If the FORMAT UNIT command CDB specifies a FMTDATA bit set to one, then the SATL shall accept a FORMAT UNIT parameter list consisting of a short or long defect list header and may accept an initialization pattern

descriptor. The SATL shall ignore any defect descriptors provided. Table 55 defines the SATL handling of fields in the FORMAT UNIT defect list header.

Table 55 — FORMAT UNIT parameter list header field translations

Field	Description or reference
PROTECTION FIELD USAGE	Unspecified (see 3.4.2)
FOV	9.4.3
DPRY	The SATL shall ignore this field.
DCRT	9.4.3 and
STPF	Unspecified (see 3.4.2)
IP	9.4.3 and 9.4.5
IMMED	9.4.3
P_I_INFORMATON [a]	Unspecified (see 3.4.2)
PROTECTION INTERVAL EXPONENT [a]	Unspecified (see 3.4.2)
DEFECT LIST LENGTH	The SATL shall ignore any defect descriptors provided.
[a] This field is only present in the long parameter list header.	

9.4.3 FORMAT UNIT parameter list header field combinations

Table 56 describes the actions the SATL takes depending on the values set in the IMMED bit, the FOV bit, the DCRT bit, and the IP bit..

Table 56 — FORMAT UNIT parameter list header field combinations

FOV	DCRT	IP	Description of SATL processing
0	0	0	The SATL may complete the command with GOOD status.
0	1	any	The SATL shall complete the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.
0	any	1	The SATL shall complete the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

[a] The FORMAT UNIT command is terminated with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

[b] The sense key is set to MEDIUM ERROR. If the failure is during the write operation, then the additional sense code is set to PERIPHERAL DEVICE WRITE FAULT. If the failure is during the certify operation, then the additional sense code is set to RECORD NOT FOUND.

Table 56 — FORMAT UNIT parameter list header field combinations

FOV	DCRT	IP	Description of SATL processing
1	1	0	The SATL shall complete the command with GOOD status without issuing any commands to the ATA device.
1	0	0	If the SATL does not support media certification, then the SATL shall terminate the command. [a] If the SATL does support media certification, then the SATL shall: 1) if the IMMED bit is set to one, then the SATL shall return GOOD status; 2) the SATL shall perform the certify operation as described in ; and 3) if the IMMED bit is set to zero and if any unrecoverable errors occur then the SATL shall return CHECK CONDITION status [b]; and 4) return GOOD status if the IMMED bit is set to zero and no unrecoverable errors occurred..
	0	1	1) If the SATL does not support the write operation described by the initialization pattern descriptor (see 9.4.5) or does not support media certification (see), then the SATL shall terminate the command [a]; 2) If the SATL does support the write operation described in 9.4.5 and if the IMMED bit is set to one, then the SATL shall return GOOD status; 3) if the SATL supports the write operation described in 9.4.5, then the SATL shall perform the write operation; 4) if the SATL supports media certification, then the SATL shall perform the certify operation as described in ; and 5) if the IMMED bit is set to zero: a) if any unrecoverable errors occur, then the SATL shall return CHECK CONDITION status [b];and b) if no unrecoverable errors occur, then the SATL shall return GOOD status.
	1	1	1) If the SATL does not support the write operation described by the initialization pattern descriptor (see 9.4.5), then the SATL shall terminate the command [a]; 2) If the SATL does support the write operation described in 9.4.5 and if the IMMED bit is set to one, then the SATL shall return GOOD status; 3) If the SATL supports the write operation described in 9.4.5, then the SATL shall perform the write operation; and 4) if the IMMED bit is set to zero: a) if any unrecoverable errors occur, then the SATL shall return CHECK CONDITION status [b]; and b) if no unrecoverable errors occur, then the SATL shall return GOOD status.

[a] The FORMAT UNIT command is terminated with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

[b] The sense key is set to MEDIUM ERROR. If the failure is during the write operation, then the additional sense code is set to PERIPHERAL DEVICE WRITE FAULT. If the failure is during the certify operation, then the additional sense code is set to RECORD NOT FOUND.

9.4.4 DCRT bit

If the DCRT bit is set to 0, send ATA verify commands (see 3.1.33) to access all the logical sectors on the medium of the ATA device that the SATL uses to emulate logical blocks accessible by the application client. For every unrecoverable read error that is encountered, the SATL shall send an ATA write command (see 3.1.35) to the defective logical sector to attempt to cause logical sector reallocation. The data written shall be

c) the data pattern specified by the initialization pattern descriptor, if any; or
d) vendor-specific if there is no initialization pattern descriptor.

After writing the affected logical sector, the SATL shall again send an ATA verify command to the same logical sector to verify the alternate logical sector is not defective. The process shall repeat until the logical sector is verified successfully or the ATA device returns an error other than an unrecoverable read error (e.g., device fault). See 5.4 for a description of error handling for multiple ATA command sequences.

9.4.5 Initialization pattern descriptor

9.4.5.1 Initialization pattern descriptor overview

If the IP bit is set to one, then the initialization descriptor fields are handled as described in table 57.

Table 57 — Initialization pattern descriptor

Field	Description or reference
SI	Unspecified (see 3.4.2)
INITIALIZATION PATTERN TYPE	For 00h or 01h, see 9.4.5.2. Otherwise, the SATL shall terminate the command [a].
INITIALIZATION PATTERN LENGTH	See 9.4.5.2.
INITIALIZATION PATTERN	See 9.4.5.2.

[a] The FORMAT UNIT command is terminated with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

9.4.5.2 Initialization pattern actions

If the SATL supports an IP bit value of one and the IP bit is set to one, then the SATL shall process the command as follows:

a) If the ATA device supports the SCT Write Same command (see ACS-3), and the value of the INITIALIZATION PATTERN LENGTH field in the initialization pattern descriptor is 0004h, then the SATL should send an ATA SCT Write Same command to the ATA device with
   A) the ATA FUNCTION CODE field set to 0001b (i.,e., Repeat Write Pattern),
   B) the ATA START field and the ATA COUNT field set to initialize the area of the media accessible by the application client, and
   C) the ATA PATTERN field set to the value of the INITIALIZATION PATTERN field from the FORMAT command initialization pattern descriptor; or
b) if the ATA SCT Write Same command is not used to write the initialization pattern, then the SATL shall write the specified pattern by issuing ATA write commands (see 3.1.35 and 9.1) to the ATA device.

9.5 OPEN ZONE command

9.5.1 OPEN ZONE command overview

The OPEN ZONE command opens the zone or zones whose identity is specified by the ZONE ID and ALL fields of the CDB. This command is applicable to ATA host aware zoned devices (see 3.1.16) and ATA host managed zoned devices (see 3.1.17). Table 58 shows the translation for fields in the OPEN ZONE CDB.

Table 58 — OPEN ZONE CDB field translations

Field	Description or reference
OPERATION CODE	Set to 94h.
SERVICE ACTION	Set to 03h
ZONE ID	If the SATL implements direct logical block mapping (see 3.1.42), then the SATL shall set the ZONE ID field in the ATA OPEN ZONE EXT command equal to the value specified in the ZONE ID field. Otherwise, the mapping is unspecified (see 3.4.2).
ALL	9.5.2
CONTROL	6.5

9.5.2 OPEN ZONE command processing

The SATL shall issue an ATA OPEN ZONE EXT command (see ZAC).

If the SATL implements direct logical block mapping, and if the ALL bit is set to zero, the zone to be closed is identified by the ZONE ID field in the CDB. If the SATL does not implement direct logical block mapping, and if the ALL bit is set to zero, identification of the zone to be opened is unspecified.

if the ALL bit is set to one, the SATL shall issue the ATA OPEN ZONE EXT command with the OPEN_ALL bit set to one in the command. The contents of the ZONE ID field is ignored.

9.6 READ commands overview

This subclause applies to the translation of SCSI read commands.

The SATL shall process a SCSI read command with the FUA bit set to zero by sending ATA read commands (see 3.1.27) in accordance with the constraints specified in 9.1 to cause the ATA device to transfer the logical blocks specified in the SCSI read command (see 3.1.83).

If the SATL returns a CHECK CONDITION status with a sense key set to a value other than ILLEGAL REQUEST while processing the command, then the SATL may transfer a vendor-specific amount of data before terminating the command. If any data is transferred before terminating the command, the sense key shall be set to a value other than ILLEGAL REQUEST.

If the SATL does not support FUA and the FUA bit is set to one, then the SATL shall terminate the SCSI READ command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

If the SATL supports FUA, then the SATL shall process a SCSI read command with the FUA bit set to one as follows:

a) If the ATA device supports NCQ (i.e., ATA IDENTIFY DEVICE data log NCQ FEATURE SET SUPPORTED bit is set to one), then the SATL shall send an ATA READ FPDMA QUEUED command (see SATA-2.6) with the ATA FUA bit in the ATA DEVICE field set to one;

or

b) If the ATA device does not support NCQ or there are no outstanding ATA queued commands, then the SATL shall:
   1) if the write cache is enabled on the ATA device (see ACS-3), send an ATA verify command (see 3.1.33) with an LBA and length matching the ATA LBA and length used for the ATA read command; and
   2) send an ATA read command as specified in accordance with the constraints specified in 9.1 to cause the ATA device to transfer the logical blocks specified in the SCSI read command (see 3.1.83).

9.7 READ (10) command

The READ (10) command is used to request the device to transfer logical blocks of user data to the application client (see SBC-3). The read operation shall be performed as specified in 9.6

Table 59 shows the translations for the fields in the READ (10) CDB,.

Table 59 — READ (10) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 28h.
RDPROTECT	Unspecified (see 3.4.2)
DPO	Unspecified (see 3.4.2)
FUA	9.6
LOGICAL BLOCK ADDRESS	If the SATL implements direct logical block mapping (see 3.1.44), then the SATL shall set the ATA LBA in the ATA read command (see 3.1.27) equal to the value specified in the LOGICAL BLOCK ADDRESS field. Otherwise, the mapping is unspecified (see 3.4.2).
GROUP NUMBER	Unspecified (see 3.4.2)
TRANSFER LENGTH[a]	If the SATL implements direct logical block mapping (see 3.1.44), then the SATL shall set the ATA Sector Count in the ATA read command (see 3.1.27) equal to the value specified in the TRANSFER LENGTH field[a]. Otherwise, the mapping is unspecified (see 3.4.2). The SATL shall send as many ATA read commands as needed to satisfy the transfer length.
CONTROL	6.5

[a] A TRANSFER LENGTH field set to zero specifies that no data transfer shall take place.

9.8 READ (12) command

The READ (12) command is used to request the device to transfer logical blocks of user data to the application client (see SBC-3). The read operation shall be performed as specified in 9.6

Table 60 shows the translation for fields in the READ (12) CDB.

Table 60 — READ (12) CDB field translations

Field	Description or reference
OPERATION CODE	Set to A8h. .
RDPROTECT	As defined in READ (10) (see 9.7).
DPO	As defined in READ (10) (see 9.7).
FUA	As defined in READ (10) (see 9.7).
~~FUA_NV~~	~~As defined in READ (10) (see 9.7).~~
LOGICAL BLOCK ADDRESS	As defined in READ (10) (see 9.7).
TRANSFER LENGTH[a]	As defined in READ (10) (see 9.7)[a].
GROUP NUMBER	As defined in READ (10) (see 9.7).
CONTROL	6.5

[a] A TRANSFER LENGTH field set to zero specifies that no data transfer shall take place.

9.9 READ (16) command

The READ (16) command is used to request the device to transfer logical blocks of user data to the application client (see SBC-3). The read operation shall be performed as specified in 9.6

Table 61 shows the translation for the fields in the READ (16) CDB.

Table 61 — READ (16) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 88h.
RDPROTECT	As defined in READ (10) (see 9.7).
DPO	As defined in READ (10) (see 9.7).
FUA	As defined in READ (10) (see 9.7).
~~FUA_NV~~	~~As defined in READ (10) (see 9.7).~~
LOGICAL BLOCK ADDRESS	As defined in READ (10) (see 9.7).

Table 61 — READ (16) CDB field translations

Field	Description or reference
TRANSFER LENGTH[a]	As defined in READ (10) (see 9.7)[a].
GROUP NUMBER	As defined in READ (10) (see 9.7).
CONTROL	6.5

[a] A TRANSFER LENGTH field set to zero specifies that no data transfer shall take place.

9.10 READ CAPACITY (10) command

9.10.1 READ CAPACITY (10) command overview

The READ CAPACITY (10) command (see SBC-3) requests that the device server transfer eight bytes of parameter data describing the capacity and medium format of the direct-access block device to the application client. The SATL shall use ATA IDENTIFY DEVICE data to compute the ATA device's maximum user addressable medium capacity of the ATA device.

Table 62 shows the translation for fields in the READ CAPACITY (10) CDB.

Table 62 — READ CAPACITY (10) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 25h.
CONTROL	6.5

9.10.2 READ CAPACITY (10) parameter data

The SATL shall return READ CAPACITY (10) parameter data as defined by SBC-3. Table 63 describes the translation of fields in the READ CAPACITY (10) parameter data.

Table 63 — READ CAPACITY (10) parameter data

Field	Description or reference
RETURNED LOGICAL BLOCK ADDRESS[a]	If the SATL implements direct logical block mapping (see clause 3.1.44), then this field shall contain the lower of: a) the ATA maximum LBA (see clause 3.1.20); or b) FFFF_FFFFh. If the SATL implements indirect logical block mapping, then this field is unspecified (see clause 3.4.2).
LOGICAL BLOCK LENGTH IN BYTES[a]	If the SATL implements direct logical block mapping (see 3.1.44) then this field shall contain the ATA logical sector size (see 3.1.19). Otherwise this field is unspecified (see 3.4.2).

[a] The values reported in the RETURNED LOGICAL BLOCK ADDRESS field and the LOGICAL BLOCK LENGTH IN BYTES field shall be such that the logical unit capacity (see 3.1.58) is less than or equal to the ATA device capacity (see 3.1.10).

9.11 READ CAPACITY (16) command

9.11.1 READ CAPACITY (16) command overview

The READ CAPACITY (16) command (see SBC-3) requests that the device server transfer parameter data describing the capacity and medium format of the direct-access block device to the application client. Table 64 shows the translation for fields in the READ CAPACITY (16) CDB.

Table 64 — READ CAPACITY(16) CDB field translations

Field or bit	Description or reference
OPERATION CODE / SERVICE ACTION	Set to 9Eh/10h.
ALLOCATION LENGTH	Unspecified (see 3.4.2)
CONTROL	6.5

9.11.2 READ CAPACITY (16) parameter data

The SATL shall return READ CAPACITY (16) parameter data as defined by SBC-3. Table 65 describes the translation of fields in the READ CAPACITY (16) parameter data.

Table 65 — READ CAPACITY (16) parameter data

Field or bit	Description or reference
RETURNED LOGICAL BLOCK ADDRESS[a]	If the SATL implements direct logical block mapping (see clause 3.1.44), then this field shall contain the ATA maximum LBA (see clause 3.1.20). If the SATL implements indirect logical block mapping, then this field is unspecified (see clause 3.4.2).
LOGICAL BLOCK LENGTH IN BYTES[a]	As defined in READ CAPACITY (10) (see clause 9.10).
P_TYPE	Unspecified (see 3.4.2)
PROT_EN	Unspecified (see 3.4.2)
P_I_EXPONENT	Unspecified (see clause 3.4.2)
LOGICAL BLOCKS PER PHYSICAL BLOCK EXPONENT	If the SATL implements direct logical block mapping (see clause 3.1.44) then this field shall contain the ATA logical sectors per physical sector exponent (see 5.8). If the SATL implements indirect logical block mapping (see clause 3.1.49), then this field is unspecified (see clause 3.4.2).
LBPME	If ATA IDENTIFY DEVICE data log TRIM SUPPORTED bit is set to one and ATA IDENTIFY DEVICE data log DRAT SUPPORTED bit is set to one, then this bit shall be set to one. Otherwise, this bit shall be set to zero.
LBPRZ	If ATA IDENTIFY DEVICE data log TRIM SUPPORTED bit is set to one, ATA IDENTIFY DEVICE data log DRAT SUPPORTED bit is set to one, and ATA IDENTIFY DEVICE data log RZAT SUPPORTED bit is set to one, then this bit shall be set to one. Otherwise, this bit shall be set to zero.
LOWEST ALIGNED LOGICAL BLOCK ADDRESS	If the SATL implements direct logical block mapping and the ATA logical sector alignment is zero, then this field shall be set to zero. If the SATL implements direct logical block mapping and the ATA logical alignment is not zero, this field shall contain the ATA logical sector alignment subtracted from the ATA logical sectors per physical sector (see 5.8). If the SATL implements indirect logical block mapping, then this field is unspecified.

[a] The values reported in the RETURNED LOGICAL BLOCK ADDRESS field and the LOGICAL BLOCK LENGTH IN BYTES field shall be such that the logical unit capacity (see 3.1.58) is less than or equal to the ATA device capacity (see 3.1.10).

9.12 REASSIGN BLOCKS command

9.12.1 REASSIGN BLOCKS command overview

The REASSIGN BLOCKS command requests that the SATL reassign logical blocks (see SBC-3). ATA devices do not support or have a direct translation for the REASSIGN BLOCKS command. Table 66 shows the translation for fields in the REASSIGN BLOCKS CDB.

Table 66 — REASSIGN BLOCKS CDB field translations

Field	Description or reference
OPERATION CODE	Set to 07h.
LONGLBA	See SBC-3
LONGLIST	See SBC-3
CONTROL	6.5

The REASSIGN BLOCKS command parameter list transferred from the application client contains the LBAs of logical blocks to be reassigned.

The SATL shall support the LONGLBA bit and the LONGLIST bit (see SBC-3).

9.12.2 REASSIGN BLOCKS operation code

The SATL shall accept a parameter list specifying LBAs of logical blocks to be reassigned (see SBC-3).

If the SATL implements direct logical block mapping (see 9.1.2), then the values set by the SATL in the ATA LBA of the ATA verify command(s) and ATA write command(s) shall equal the value(s) of the LBAs in the parameter list. Otherwise, the mapping is unspecified (see 3.4.2).

The SATL shall process each ATA LBA corresponding to LBAs specified in the parameter list as shown in figure 12.

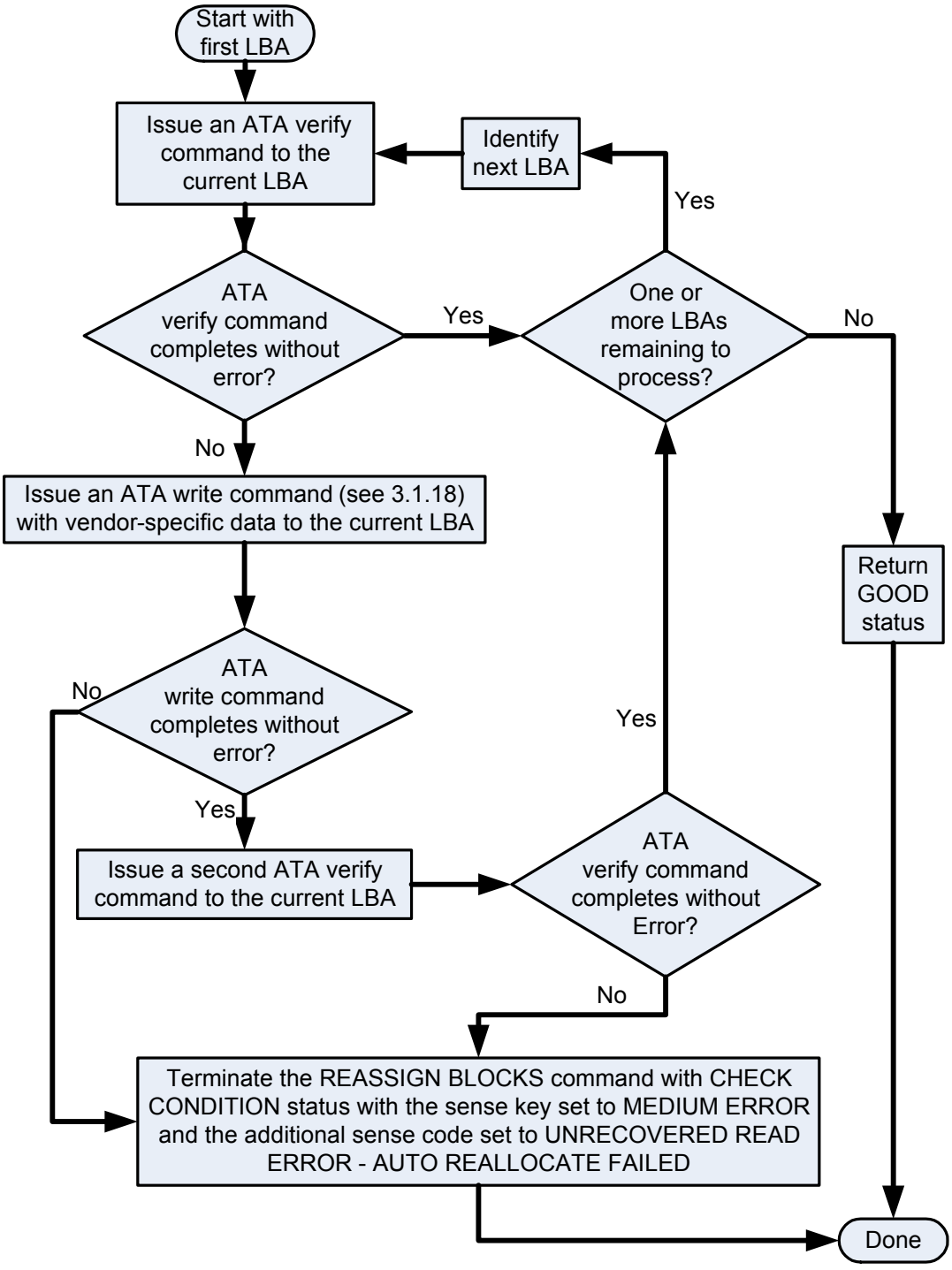


Figure 12 — REASSIGN BLOCKS command translation

9.13 REPORT ZONES command

9.13.1 REPORT ZONES command overview

The REPORT ZONES command returns parameter data that returns the identifiers and attributes of a selected set of zones (see ZBC) on the device. This command is applicable to ATA host aware zoned devices (see 3.1.16) and ATA host managed zoned devices (see 3.1.17). Table 67 shows the translation for fields in the REPORT ZONES CDB.

Table 67 — REPORT ZONES field translations

Field	Description or reference
OPERATION CODE	Set to 95h.
SERVICE ACTION	Set to 00h
ZONE START LBA	If the SATL implements direct logical block mapping (see 3.1.42), then the SATL shall set the ZONE START LBA field in the ATA REPORT ZONES EXT command equal to the value specified in the ZONE START LBA field. Otherwise, the mapping is unspecified (see 3.4.2).
ALLOCATION LENGTH	9.13.3
REPORTING OPTIONS	The SATL shall set the REPORTING OPTIONS field of the ATA REPORT ZONES EXT command to the value specified in the REPORTING OPTIONS field.
CONTROL	6.5

9.13.2 REPORT ZONES command processing

The SATL shall issue an ATA REPORT ZONES EXT command (see ZAC).

If the SATL implements direct logical block mapping, the ZONE START LBA field identifies the starting zone to be reported. If the device does not implement direct logical block mapping, the zones to be reported are unspecified.

9.13.3 ALLOCATION LENGTH field

The SATL shall issue the ATA REPORT ZONES EXT command with the COUNT field set to (ALLOCATION_LENGTH + 511)/512.

9.13.4 REPORT ZONES parameter data

The REPORT ZONES parameter data is defined in table 68

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Table 68 — REPORT ZONES parameter data

FIELD OR BIT	Description or reference
ZONE LIST LENGTH	This field shall contain the contents of the zone list length field in the ATA Report Zones descriptor.
SAME	If the SATL implements direct logical block mapping (see 3.1.44), then this field shall contain the contents of the SAME field in the ATA Report Zones descriptor. Otherwise, this is unspecified (see 3.4.2)
MAXIMUM LBA	If the SATL implements direct logical block mapping (see 3.1.44), then this field shall contain the ATA maximum LBA (see 3.1.20) If the SATL implements indirect logical block mapping, then this field is unspecified (see 3.4.2).
ZONE TYPE	If the SATL implements direct logical block mapping, this shall contain the contents of the ZONE TYPE field of the ATA Report Zones descriptor for the identified zone (see ZAC). Otherwise, this is unspecified (see 3.4.2)
ZONE CONDITION	If the SATL implements direct logical block mapping, this shall contain the contents of the ZONE CONDITION field from the ATA Report Zones descriptor for the identified zone (see ZAC). Otherwise, this is unspecified (see 3.4.2)
NON_SEQ	If the SATL implements direct logical block mapping, thisshall contain the contents of the NON_SEQ field from the ATA Report zones descriptor for the identified zone (see ZAC). Otherwise, this is unspecified (see 3.4.2)
RESET	If the SATL implements direct logical block mapping, thisshall contain the contents of the RESET field from the ATA Report Zones descriptor for the identified zone (see ZAC). If the SATL implements indirect logical block mapping (see 3.1.49), then this field is unspecified (see 3.4.2).
ZONE LENGTH	If the SATL implements direct logical block mapping, thisshall contain the contents of the ZONE LENGTH field from the ATA Report Zones descriptor for the identified zone (see ZAC). Otherwise, this is unspecified (see 3.4.2)
ZONE START LBA	If the SATL implements direct logical block mapping, this shall contain the contents of the ZONE START LBA field from the ATA Report Zones descriptor for the identified zone (see ZAC). Otherwise, this is unspecified (see 3.4.2)
WRITE POINTER LBA	If the SATL implements direct logical block mapping, thisshall contain the contents of the WRITE POINTER LBA field from the ATA Report Zones descriptor for the identified zone (see ZAC). If the SATL implements indirect logical block mapping, then this field is unspecified (see 3.4.2).

The number of bytes returned shall be the smaller of (ZONE LIST LENGTH + 64) and the contents of the ALLOCATION LENGTH field in the request.

9.14 RESET WRITE POINTER command

9.14.1 RESET WRITE POINTER command overview

The RESET WRITE POINTER command resets the write pointer (see ZBC) in the zone or zones identified by the ZONE ID and ALL fields of the CDB. This command is applicable to ATA host aware zoned devices (see 3.1.16) or ATA host managed zoned devices (see 3.1.17). Table 69 shows the translation for fields in the RESET WRITE POINTER CDB.

Table 69 — RESET WRITE POINTER field translations

Field	Description or reference
OPERATION CODE	Set to 94h.
SERVICE ACTION	Set to 04h
ZONE ID	If the SATL implements direct logical block mapping (see 3.1.44), then the SATL shall set the ZONE ID field in the ATA RESET WRITE POINTER EXT command equal to the value specified in the ZONE ID field. Otherwise, the mapping is unspecified (see 3.4.2).
ALL	9.14.2
CONTROL	6.5

9.14.2 RESET WRITE POINTER command processing

The SATL shall issue an ATA RESET WRITE POINTER EXT command (see ZAC). If the SATL implements direct logical block mapping, and if the ALL BIT is set to zero, the zone is identified by the ZONE ID field in the CDB. If the SATL does not implement direct logical block mapping, and if the ALL bit is set to zero, identification of the zone whose write pointer is reset is unspecified.

If the ALL bit is set to one, the SATL shall issue the ATA RESET WRITE POINTER EXT command with the RESET_ALL bit set to one. The contents of the ZONE ID field are ignored.

9.15 SANITIZE command

9.15.1 SANITIZE command overview

The SANITIZE command specifies that one of several sanitize operations be performed. Table 70 shows the translation for the fields of the SANITIZE CDB.

Table 70 — SANITIZE CDB field translations

Field	Description or Reference
OPERATION CODE	Set to 48h.
IMMED	If set to one, then the SATL shall validate all CDB and data fields, if any, before returning GOOD status [a]. If set to zero, then the SATL shall wait for completion of all commands issued to the ATA device before returning status.
AUSE	See 9.15.2.2, 9.15.3, and 9.15.4.
SERVICE ACTION	If set to 01h (i.e., OVERWRITE), see 9.15.2 If set to 02h (i.e., BLOCK ERASE), see 9.15.3. If set to 03h (i.e., CRYPTOGRAPHIC ERASE), see 9.15.4. If set to 1Fh (i.e., EXIT FAILURE MODE), see 9.15.5. If set to any other value, the SATL shall terminate the SANITIZE command with CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB.
PARAMETER LIST LENGTH	If: a) the SERVICE ACTION field is set to 01h and the PARAMETER LIST LENGTH field is not set to 0008h; or b) the SERVICE ACTION field is set to 02h and the PARAMETER LIST LENGTH field is not set to 0000h; or c) the SERVICE ACTION field is set to 03h and the PARAMETER LIST LENGTH field is not set to 0000h; or d) the SERVICE ACTION field is set to 1Fh and the PARAMETER LIST LENGTH field is not set to 0000h; then the SATL shall terminate the SANITIZE command with CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB.
CONTROL	6.5

[a] Additional verification requirements if the IMMED bit is set to one are described in 9.15.2, 9.15.3, and 9.15.4.

9.15.2 Sanitize using overwrite method

9.15.2.1 OVERWRITE service action parameter list translation

For the SANITIZE command with the overwrite method, the data parameters are translated as shown in table 71.

Table 71 — OVERWRITE service action parameter list translation

Field	Description or reference
INVERT	9.15.2.2
OVERWRITE COUNT	If the OVERWRITE COUNT field is set to 00h or set to a value greater than 10h, then the SATL shall terminate the SANITIZE command with CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN PARAMETER LIST.
INITIALIZATION PATTERN LENGTH	If this field is not set to 0004h, then the SATL shall terminate the SANITIZE command with CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN PARAMETER LIST.
INITIALIZATION PATTERN	These four bytes shall be treated as a data dword for translation to an ATA DWord.

9.15.2.2 Sanitize using overwrite method translation details

If the SATL supports the overwrite method, then the SATL shall:

1) if the ATA IDENTIFY DEVICE data log OVERWRITE SUPPORTED bit is set to zero (i.e., ATA OVERWRITE EXT command is not supported), then terminate the SANITIZE command with CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB;
2) If the ATA IDENTIFY DEVICE data log OVERWRITE SUPPORTED bit is set to one, no CHECK CONDITION status was returned as a result of processing the fields in table 71, and the IMMED bit is set to one, then return GOOD status;
3) If the ATA IDENTIFY DEVICE data log OVERWRITE SUPPORTED bit is set to one and no CHECK CONDITION status was returned as a result of processing the fields in table 71, then issue an ATA OVERWRITE EXT command with:
   A) the ATA COUNT field INVERT PATTERN BETWEEN OVERWRITE PASSES bit set to the value of the INVERT bit;
   B) the ATA FAILURE MODE bit set to the value of the AUSE bit;
   C) the ATA COUNT field OVERWRITE PASS COUNT set to 0h if the OVERWRITE COUNT field is equal to 10h or set to the value of the OVERWRITE COUNT field if the value is from 01h to 0Fh;
   D) the ATA LBA bits 47:32 set to 4F57h; and
   E) the ATA OVERWRITE PATTERN field set to the value of the INITIALIZATION PATTERN field;
4) if the ATA OVERWRITE EXT command in step 3 completes with an error and the IMMED bit is set to zero, then terminate the SANITIZE command with CHECK CONDITION status with sense key and additional sense code set according to the reported ATA error as described in clause 11;
5) periodically issue ATA SANITIZE STATUS EXT commands until the returned status indicates completion of the sanitize operation; and
6) if the ATA OVERWRITE EXT command in step 4 completed without error and the IMMED bit is set to zero (i.e., the SATL has not yet returned status for the SANITIZE command):
   A) if the last ATA SANITIZE STATUS EXT command in step 5 indicates completion without error, then return GOOD status; or

B) otherwise if the last ATA SANITIZE STATUS EXT command in step 5 indicates completion with error then return CHECK CONDITION status with sense key set to MEDIUM ERROR and the additional sense code set to SANITIZE COMMAND FAILED.

If the SATL does not support the overwrite method, the SATL shall return CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB.

9.15.3 Sanitize using block erase method

If the SATL supports the block erase method, then the SATL shall:

1) if the ATA IDENTIFY DEVICE data log BLOCK ERASE SUPPORTED bit is set to zero (i.e., ATA BLOCK ERASE EXT command is not supported), then the SANITIZE command shall be terminated with CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB;
2) If the ATA IDENTIFY DEVICE data log BLOCK ERASE SUPPORTED bit is set to one and the IMMED bit is set to one, then the SATL return GOOD status;
3) If the ATA IDENTIFY DEVICE data log BLOCK ERASE SUPPORTED bit is set to one, then issue an ATA BLOCK ERASE EXT command with the ATA FAILURE MODE bit set to the value of the AUSE bit,ATA LBA bits 47:32 set to zero, and ATA LBA bits 31:0 set to 426B_4572h;
4) if the ATA BLOCK ERASE EXT command in step 3 completes with an error and the IMMED bit is set to zero, then terminate the SANITIZE command with CHECK CONDITION status with sense key and additional sense code set according to the reported ATA error as described in clause 11;
5) periodically issue ATA SANITIZE STATUS EXT commands until the returned status indicates completion of the sanitize operation; and
6) if the IMMED bit is set to zero (i.e., the SATL has not yet returned status for the SANITIZE command):
   A) if the last ATA SANITIZE STATUS EXT command in step 5 indicates completion without error, then return GOOD status; or
   B) if the last ATA SANITIZE STATUS EXT command in step 5 indicates completion with error then terminate the SANITIZE command with CHECK CONDITION status with sense key set to MEDIUM ERROR and the additional sense code set to SANITIZE COMMAND FAILED.

If the SATL does not support the block erase method, the SATL shall return CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB.

9.15.4 Sanitize using cryptographic erase method

If the SATL supports the cryptographic erase method, then the SATL shall:

1) if the ATA IDENTIFY DEVICE data log CRYPTO SCRAMBLE SUPPORTED bit is set to zero (i.e., ATA CRYPTO SCRAMBLE EXT command is not supported), then terminate the SANITIZE command with CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB;
2) if the ATA IDENTIFY DEVICE data log CRYPTO SCRAMBLE SUPPORTED bit is set to one and the IMMED bit is set to one, then return GOOD status;
3) if the ATA IDENTIFY DEVICE data log CRYPTO SCRAMBLE SUPPORTED bit is set to one, then issue an ATA CRYPTO SCRAMBLE EXT command with ATA FAILURE MODE bit set to the value of the AUSE bit, ATA LBA 47:32 set to zero, and ATA LBA 31:0 set to 4372_7970h;
4) if the ATA CRYPTO SCRAMBLE EXT command in step 3 completes with an error and the IMMED bit is set to zero, then terminate the SANITIZE command with CHECK CONDITION status with sense key and additional sense code set according to the reported ATA error as described in clause 11;
5) periodically issue ATA SANITIZE STATUS EXT commands until the returned status indicates completion of the sanitize operation; and
6) if the IMMED bit is set to zero (i.e., the SATL has not yet returned status for the SANITIZE command):
   A) if the last ATA SANITIZE STATUS EXT command in step 5 indicates completion without error, then return GOOD status; or
   B) if the last ATA SANITIZE STATUS EXT command in step 5 indicates completion with error then return CHECK CONDITION status with sense key set to MEDIUM ERROR and the additional sense code set to SANITIZE COMMAND FAILED.

If the SATL does not support the cryptographic erase method, the SATL shall return CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB.

9.15.5 Exit the sanitize failure mode

To process the exit failure mode request, the SATL shall:

1) if the ATA IDENTIFY DEVICE data log SANITIZE SUPPORTED bit is set to zero (i.e., ATA Sanitize feature set is not supported), then the SANITIZE command shall be terminated with CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB;
2) if the ATA IDENTIFY DEVICE data log SANITIZE SUPPORTED bit is set to one and the IMMED bit is set to one, return GOOD status;
3) if the ATA IDENTIFY DEVICE data log SANITIZE SUPPORTED bit is set to one, then issue an ATA SANITIZE STATUS EXT command with the CLEAR SANITIZE OPERATION FAILED bit set to one;
4) periodically issue ATA SANITIZE STATUS EXT commands until the returned status indicates completion of the sanitize operation; and
5) if the IMMED bit is set to zero (i.e., the SATL has not yet returned status for the SANITIZE command), then:
   A) if the ATA SANITIZE STATUS EXT command indicates completion without error, then the SATL shall return GOOD status; or
   B) if the ATA SANITIZE STATUS EXT command indicates completion with error then the SANITIZE command shall be terminated with CHECK CONDITION status with sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

9.16 START STOP UNIT command

9.16.1 START STOP UNIT command overview

The START STOP UNIT command provides a method for controlling the power condition of a logical unit.

The POWER CONDITION field is used to specify that the logical unit be placed into a specific power condition or to cause a timer expiration as defined in table 72. If the POWER CONDITION field contains a value other than 0h, then the SATL shall not consider the ATA device to be in the stopped power condition (see SBC-3).

Table 72 shows the translation for fields in the START STOP UNIT CDB.

Table 72 — START STOP UNIT CDB field translations

Field	Description or reference
OPERATION CODE	Set to 1Bh.
IMMED	The SATL shall implement this field as defined in 9.16.2 and 9.16.3.
POWER CONDITION MODIFIER	a) If non-zero values are not supported by the SATL and the field contains a non-zero value, then the SATL shall terminate the START STOP UNIT command [a]; or b) If non-zero value are supported by the SATL and the ATA EPC feature is supported [b], then see table 73, otherwise see table 74.
POWER CONDITION	a) If non-zero values are not supported by the SATL and the field contains a non-zero value, then the SATL shall terminate the START STOP UNIT command [a]; or b) If non-zero value are supported by the SATL and the ATA EPC feature is supported [b], then see table 73, otherwise see table 74.
NO_FLUSH	See 9.16.4
LOEJ	The SATL shall implement this field as defined in 9.16.3.
START	The SATL shall implement this field as defined in 9.16.3.
CONTROL	6.5

[a] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

[b] The ATA EPC feature set is supported if the ATA IDENTIFY DEVICE data log EPC SUPPORTED bit is set to one.

Table 73 describes the translations for the POWER CONDITION field if ATA EPC is supported.

Table 73 — POWER CONDITION field translation with ATA EPC (part 1 of 6)

Code	Name	Description or reference
00h	START_VALID	The SATL shall process the LOEJ and START fields as defined in 9.16.3.
01h	ACTIVE	The SATL shall: 1) if the IMMED bit is set to one, then return GOOD status; 2) disable all of the supported power condition timers by sending an ATA SET FEATURES - Set Power Condition State command with: A) the ATA POWER CONDITION ID field set to FFh; B) the ATA ENABLE bit set to zero; and C) the ATA SAVE bit set to zero; 3) if the ATA SET FEATURES command in step 2 completes with an error, then process ending status according to the IMMED bit (see 9.16.2) [b]; 4) if the ATA SET FEATURES command in step 2 completes without error, then send an ATA verify [a] command (see 3.1.33) to the ATA device with A) the ATA Sector Count set to one, B) the ATA LBA field set to a value between zero and the maximum LBA supported by the ATA device in its current configuration; 5) if the ATA verify command in step 4 completes with an error, then process ending status according to the IMMED bit (see 9.16.2) with the sense key set to ABORTED COMMAND and additional sense code set to COMMAND SEQUENCE ERROR; and 6) if the ATA verify command in step 4 completes without error then: A) if the IMMED bit is set to zero, then return GOOD status ; and B) the SATL shall no longer consider the ATA device to be in the stopped power state.

[a] For ATA devices compliant with versions of ATA prior to ACS-2, ATA device medium access occurs if an LBA is specified whose data is not contained in the ATA device's cache memory. If a LBA value is specified for an ATA verify command where the data is contained in the ATA device's cache memory, then the ATA device may not be in the Active power mode after completion of the ATA verify command.

[b] Process the ending status with the sense key set to ABORTED COMMAND and additional sense code set to COMMAND SEQUENCE ERROR.

[c] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

Table 73 — POWER CONDITION field translation with ATA EPC (part 2 of 6)

Code	Name	Description or reference
02h	IDLE	The SATL shall: 1) determine if the idle condition specified in the POWER CONDITION MODIFIER field (i.e., idle_a, idle_b, idle_c) is supported by reading the ATA Power Conditions Log and testing if the POWER CONDITION SUPPORTED bit is set to one in the corresponding power conditions descriptor, 2) if the specified ATA power condition is not supported, then terminate the STOP START UNIT command [c]; and 3) if the specified ATA power condition is supported then: 1) if the IMMED bit is set to one, then return GOOD status; 2) If the NO_FLUSH bit is set to zero, then send an ATA flush command (see 3.1.13) to the ATA device; 3) if the ATA flush command in substep 2) of step 3)completes with an error, then process ending status according to the IMMED bit (see 9.16.2) [b]; 4) if the NO_FLUSH bit is set to zero or the ATA flush command in substep 2) of step3)completes without an error, then disable all supported power condition timers by sending an ATA SET FEATURES - Set Power Condition State command with: a) the ATA POWER CONDITION ID field set to FFh; b) the ATA ENABLE bit set to zero; and c) the ATA SAVE bit set to zero; 5) if the ATA SET FEATURES command in substep 4) of step 3) completed with an error, then process ending status according to the IMMED bit (see 9.16.2) [b]; 6) if the ATA SET FEATURES command in substep 4) of step 3) completed without error, then send an ATA SET FEATURES - Go to Power Condition command with the ATA POWER CONDITION ID field set to the value of the POWER CONDITION MODIFIER field incremented by 81h. 7) if the ATA SET FEATURES command in substep 6) of step 3) completes with an error, then process the ending status according to the IMMED bit (see 9.16.2) [b]; and 8) if the ATA SET FEATURES command in substep 6) of step 3) completes without an error and the IMMED bit is set to zero, then return GOOD status.

[a] For ATA devices compliant with versions of ATA prior to ACS-2, ATA device medium access occurs if an LBA is specified whose data is not contained in the ATA device's cache memory. If a LBA value is specified for an ATA verify command where the data is contained in the ATA device's cache memory, then the ATA device may not be in the Active power mode after completion of the ATA verify command.

[b] Process the ending status with the sense key set to ABORTED COMMAND and additional sense code set to COMMAND SEQUENCE ERROR.

[c] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

Table 73 — POWER CONDITION field translation with ATA EPC (part 3 of 6)

Code	Name	Description or reference
03h	STANDBY	The SATL shall: 1) determine if the standby condition specified in the POWER CONDITION MODIFIER field (i.e., standby_y or standby_z) is supported by reading the ATA Power Conditions Log (page 01h) and testing if the POWER CONDITION SUPPORTED bit is set to one in the corresponding power conditions descriptor; 2) if the specified ATA power condition is not supported then terminate the START STOP UNIT command[c]; and 3) if the specified ATA power condition is supported then: 1) if the IMMED bit is set to one, then return GOOD status; 2) if the NO_FLUSH bit is set to zero, then send an ATA flush command (see 3.1.13) to the ATA device; 3) if the ATA flush command in substep 2) of step 3) completes with an error, then process ending status according to the IMMED bit (see 9.16.2) [b]; 4) if the NO_FLUSH bit is set to one or the ATA flush command in substep 2) of step 3) completes without error, then disable all of the supported power condition timers by sending an ATA SET FEATURES - Set Power Condition State command with: a) the ATA POWER CONDITION ID field set to FFh; b) the ATA ENABLE bit set to zero; and c) the ATA SAVE bit set to zero; 5) if the ATA SET FEATURES command in substep 4)of step 3) completes with an error, then process ending status according to the IMMED bit (see 9.16.2) [b]; 6) if the ATA SET FEATURES command in substep 4) of step 3) completes without an error, then send an ATA SET FEATURES - Go to Power Condition command with the ATA POWER CONDITION ID field set to the value of the POWER CONDITION MODIFIER field incremented by one; 7) if the ATA SET FEATURES command in substep 6) of step 3) completes with an error, then process the ending status according to the IMMED bit (see 9.16.2) [b]; and 8) if the ATA SET FEATURES command in substep 6) of step 3)three completes without error and the IMMED bit is set to zero, then return GOOD status (see 9.16.2).

[a] For ATA devices compliant with versions of ATA prior to ACS-2, ATA device medium access occurs if an LBA is specified whose data is not contained in the ATA device's cache memory. If a LBA value is specified for an ATA verify command where the data is contained in the ATA device's cache memory, then the ATA device may not be in the Active power mode after completion of the ATA verify command.

[b] Process the ending status with the sense key set to ABORTED COMMAND and additional sense code set to COMMAND SEQUENCE ERROR.

[c] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

Table 73 — POWER CONDITION field translation with ATA EPC (part 4 of 6)

Code	Name	Description or reference
07h	LU_CONTROL	The SATL shall: 1) if the POWER CONDITION MODIFIER field is non-zero, then terminate the START STOP UNIT command [c]; and 2) if the POWER CONDITION MODIFIER field is zero, then: 1) if the IMMED bit is set to one, then return GOOD status; 2) enable the power condition timers by sending an ATA SET FEATURES - Set Power Condition State command with: a) the ATA POWER CONDITION ID field set to FFh; b) the ATA ENABLE bit set to one; and c) the ATA SAVE bit set to zero; 3) if the ATA SET FEATURES command in substep 2) of step 2) completed with an error, then process the ending status according to the IMMED bit (see 9.16.2) [b]; and 4) if the ATA SET FEATURES command in substep 2) of step 2) completed without error and the IMMED bit is set to zero, then return GOOD status.

[a] For ATA devices compliant with versions of ATA prior to ACS-2, ATA device medium access occurs if an LBA is specified whose data is not contained in the ATA device's cache memory. If a LBA value is specified for an ATA verify command where the data is contained in the ATA device's cache memory, then the ATA device may not be in the Active power mode after completion of the ATA verify command.

[b] Process the ending status with the sense key set to ABORTED COMMAND and additional sense code set to COMMAND SEQUENCE ERROR.

[c] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

Table 73 — POWER CONDITION field translation with ATA EPC (part 5 of 6)

Code	Name	Description or reference
0Ah	FORCE_IDLE_0	The SATL shall: 1) determine if the idle condition specified in the POWER CONDITION MODIFIER field (i.e., idle_a, idle_b, or idle_c) is supported by reading the ATA Power Conditions Log (page 00h) and testing if the POWER CONDITION SUPPORTED bit is set to one in the corresponding power conditions descriptor,; 2) if the specified ATA power condition is not supported then terminate the START STOP UNIT command [c]; and 3) if the specified ATA power condition is supported then: 1) if the IMMED bit is set to one, then return GOOD status; 2) if the NO_FLUSH bit is set to zero, then send an ATA flush command (see 3.1.13) to the ATA device; 3) if the ATA flush command in substep 2) of step 3) completes with an error, then process ending status according to the IMMED bit (see 9.16.2) [b]; 4) if the NO_FLUSH bit is set to one or the ATA flush command in substep 2)of step 3) completes without error, then enable all of the supported power condition timers by sending an ATA SET FEATURES – Set Power Condition State command with: a) the ATA POWER CONDITION ID set to FFh; b) the ATA ENABLE bit set to one; and c) the ATA SAVE bit set to zero; 5) if the ATA SET FEATURES command in substep four of step three completes with an error, then process the ending status according to the IMMED bit (see 9.16.2) [b]; 6) if the ATA SET FEATURES command in substep 4) of step 3) completes without error, then send an ATA SET FEATURES – Go to Power Condition command with the ATA POWER CONDITION ID set to the value of the POWERCONDITION MODIFIER field incremented by 81h; 7) if the ATA SET FEATURES command in substep 6) of step 3) completes with an error, then process the ending status according to the IMMED bit (see 9.16.2) [b]; and 8) if the ATA SET FEATURES command in substep 6) of step 3) completes without error and the IMMED bit is set to zero, then return GOOD status.

[a] For ATA devices compliant with versions of ATA prior to ACS-2, ATA device medium access occurs if an LBA is specified whose data is not contained in the ATA device's cache memory. If a LBA value is specified for an ATA verify command where the data is contained in the ATA device's cache memory, then the ATA device may not be in the Active power mode after completion of the ATA verify command.

[b] Process the ending status with the sense key set to ABORTED COMMAND and additional sense code set to COMMAND SEQUENCE ERROR.

[c] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

Table 73 — POWER CONDITION field translation with ATA EPC (part 6 of 6)

Code	Name	Description or reference
0Bh	FORCE_STANDBY_0	The SATL shall: 1) determine if the standby condition specified in the POWER CONDITION MODIFIER field (i.e., standby_y or standby_z) is supported by reading the ATA Power Conditions Log (page 01h) and testing if the POWER CONDITION SUPPORTED bit is set to one in the corresponding power conditions descriptor; 2) if the specified ATA power condition is not supported then terminate the START STOP UNIT command [c]; and 3) if the specified ATA power condition is supported then: 1) if the IMMED bit is set to one, then return GOOD status; 2) ifthe NO_FLUSH bit is set to zero, then send an ATA flush command (see 3.1.13) to the ATA device; 3) if the ATA flush command in substep 2) of step 3) completes with an error, then process ending status according to the IMMED bit (see 9.16.2) [b]; 4) if the NO_FLUSH bit is set to one or the ATA flush command in substep 2) of step 3) completes without error, then enable all of the supported power condition timers by sending an ATA SET FEATURES – Set Power Condition State command with: a) the ATA POWER CONDITION ID set to FFh; b) the ATA ENABLE bit set to one; and c) the ATA SAVE bit set to zero; 5) if the ATA SET FEATURES command in substep 4) of step 3) completes with an error, then process the ending status according to the IMMED bit (see 9.16.2) [b]; 6) if the ATA SET FEATURES command in substep 4) of step 3) completes without error, then send an ATA SET FEATURES – Go to Power Condition command with the ATA POWER CONDITION ID set to the value of the POWER CONDITION MODIFIER field incremented by 1h; 7) if the ATA SET FEATURES command in substep 6) of step 3) completes with an error, then process the ending status according to the IMMED bit (see 9.16.2) [b]; and 8) if the ATA SET FEATURES command in substep 6) of step 3) completes without error and the IMMED bit is set to zero, then return GOOD status.
All other values	The SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.	

[a] For ATA devices compliant with versions of ATA prior to ACS-2, ATA device medium access occurs if an LBA is specified whose data is not contained in the ATA device's cache memory. If a LBA value is specified for an ATA verify command where the data is contained in the ATA device's cache memory, then the ATA device may not be in the Active power mode after completion of the ATA verify command.

[b] Process the ending status with the sense key set to ABORTED COMMAND and additional sense code set to COMMAND SEQUENCE ERROR.

[c] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

Table 74 describes the translation of the POWER CONDITION MODIFIER field when ATA EPC is not supported

Table 74 — POWER CONDITION field translation without ATA EPC (part 1 of 5)

Code	Name	Description or reference
00h	START_VALID	The SATL shall process the LOEJ and START fields as defined in 9.16.3.
01h	ACTIVE	The SATL shall: 1) if the IMMED bit is set to one, then return GOOD status; 2) send an ATA IDLE command to the ATA device with the ATA FEATURE field set to zero, the ATA COUNT field set to zero, and the ATA LBA field set to zero; 3) if the ATA IDLE command in step 2) completes with an error, then process ending status according to the IMMED bit (see 9.16.2)[b]; 4) if the ATA IDLE command in step 2) completes without error, then send an ATA verify [a] command (see 3.1.33) to the ATA device with the ATA COUNT field set to one and the LBA set to a value between zero and the maximum LBA supported by the ATA device in its current configuration; 5) if the ATA verify command in step 4) completes with an error, then process ending status according to the IMMED bit (see 9.16.2)[b]; and 6) if the ATA verify command in step 4) completes without error and the IMMED bit is set to zero, then: A) return GOOD status; and B) the SATL shall no longer consider the ATA device to be in the stopped power state.

[a] For ATA devices compliant with versions of ATA prior to ACS-2, the ATA device medium access occurs when an LBA is specified whose data is not contained in the ATA device's cache memory. If an LBA value is specified for an ATA verify command where the data is contained in the ATA device's cache memory, then the ATA device may not be in the Active power mode after completion of the ATA verify command.

[b] Process the ending status with the sense key set to ABORTED COMMAND and additional sense code set to COMMAND SEQUENCE ERROR.

[c] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

Table 74 — POWER CONDITION field translation without ATA EPC (part 2 of 5)

Code	Name	Description or reference
02h	IDLE	The SATL shall: 1) if the IMMED bit is set to one, then return GOOD status; 2) if the NO_FLUSH bit is set to zero, then send an ATA flush command (see 3.1.13) to the ATA device; 3) if the ATA flush command in step 2) completes with an error, then process ending status according to the IMMED bit (see 9.16.2)[b]; and 4) if the NO_FLUSH bit is set to one or ATA flush command in step 2) completes without error, then: A) if the POWER CONDITION MODIFIER field is set to zero, then: 1) send an ATA IDLE command to the ATA device with the ATA FEATURE field set to zero, the ATA COUNT field set to zero, and the ATA LBA field set to zero; 2) if the ATA IDLE command in substepA)1) completes with an error, then process ending status according to the IMMED bit (see 9.16.2) [c]; and 3) if the ATA IDLE command in step A)1) completes without error and the IMMED bit is set to zero, then return GOOD status; and B) if the POWER CONDITION MODIFIER field is not set to zero, then: 1) send an ATA IDLE command to the ATA device with the ATA FEATURE field set to zero, the ATA COUNT field set to zero, and the ATA LBA field set to zero; 2) if the ATA IDLE command in step B)1) completes with an error, then process ending status according to the IMMED bit (see 9.16.2) [c]; 3) if the ATA IDLE command in step B)1) completes without error and ATA IDENTIFY DEVICE data logUNLOAD SUPPORTED bit is set to zero and the IMMED bit is set to zero, then return GOOD status (see 9.16.2); 4) if the ATA IDLE command in step B)1) completes without error and ATA IDENTIFY DEVICE data logUNLOAD SUPPORTED bit is set to one, then send an ATA IDLE IMMEDIATE command to the ATA device with the ATA FEATURE field set to 44h, the ATA COUNT field set to zero, and the ATA LBA field set to 55_4E4Ch; 5) if the ATA IDLE IMMEDIATE command in step B)4) completes with any error, then process ending status according to the IMMED bit (see 9.16.2) [c]; and 6) If the ATA IDLE IMMEDIATE command in step B)4) completes without error and the IMMED bit is set to zero, then return GOOD status.

[a] For ATA devices compliant with versions of ATA prior to ACS-2, the ATA device medium access occurs when an LBA is specified whose data is not contained in the ATA device's cache memory. If an LBA value is specified for an ATA verify command where the data is contained in the ATA device's cache memory, then the ATA device may not be in the Active power mode after completion of the ATA verify command.

[b] Process the ending status with the sense key set to ABORTED COMMAND and additional sense code set to COMMAND SEQUENCE ERROR.

[c] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

Table 74 — POWER CONDITION field translation without ATA EPC (part 3 of 5)

Code	Name	Description or reference
03h	STANDBY	The SATL shall: 1) if the IMMED bit is set to one, then return GOOD status; 2) if the NO_FLUSH bit is set to zero, then send an ATA flush command (see 3.1.11) to the ATA device; 3) if the ATA flush command in step 2) completes with an error, then process ending status according to the IMMED bit (see 9.16.2)[a]; 4) if the NO_FLUSH bit is set to one or ATA flush command in step 2) completes without error, then the SATL shall send an ATA STANDBY command to the ATA device with the ATA COUNT field set to zero; 5) if the ATA STANDBY command in step 4) completes with an error, then process ending status according to the IMMED bit (see 9.11.2)[b]; and 6) If the ATA STANDBY command in step 4) completes without error and the IMMED bit is set to zero, then return GOOD status.

[a] For ATA devices compliant with versions of ATA prior to ACS-2, the ATA device medium access occurs when an LBA is specified whose data is not contained in the ATA device's cache memory. If an LBA value is specified for an ATA verify command where the data is contained in the ATA device's cache memory, then the ATA device may not be in the Active power mode after completion of the ATA verify command.

[b] Process the ending status with the sense key set to ABORTED COMMAND and additional sense code set to COMMAND SEQUENCE ERROR.

[c] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

Table 74 — POWER CONDITION field translation without ATA EPC (part 4 of 5)

Code	Name	Description or reference
07h	LU_CONTROL	The SATL shall: 1) if the IMMED bit is set to one, then return GOOD status; 2) send an ATA CHECK POWER MODE command to the ATA device; 3) if the ATA COUNT field returned from the ATA CHECK POWER MODE command is 00h, then: 1) send an ATA STANDBY command to the ATA device with the ATA COUNT field set to the previously saved value of the ATA standby timer (see 10.1.11.2); 2) if the ATA STANDBY command completes with any error, then process ending status according to the IMMED bit (see 9.11.2)[b]; and 3) if the ATA STANDBY command completes without error and the IMMED bit is set to zero, then return GOOD status (see 9.11.2); 4) if the ATA COUNT field returned from the ATA CHECK POWER MODE command is 80h, then: 1) send an ATA IDLE command to the ATA device with the ATA COUNT field set to the previously saved value of the ATA standby timer (see 10.1.11.2); 2) if the ATA IDLE command completes with any error, then process ending status according to the IMMED bit (see 9.11.2)[b]; and 3) if the ATA IDLE command completes without error and the IMMED bit is set to zero, then return GOOD status; and

[a] For ATA devices compliant with versions of ATA prior to ACS-2, the ATA device medium access occurs when an LBA is specified whose data is not contained in the ATA device's cache memory. If an LBA value is specified for an ATA verify command where the data is contained in the ATA device's cache memory, then the ATA device may not be in the Active power mode after completion of the ATA verify command.

[b] Process the ending status with the sense key set to ABORTED COMMAND and additional sense code set to COMMAND SEQUENCE ERROR.

[c] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

Table 74 — POWER CONDITION field translation without ATA EPC (part 5 of 5)

Code	Name	Description or reference
07h (con't)	LU_CONTROL (con't)	5) if the ATA COUNT field returned from the ATA CHECK POWER MODE command is 40h, 41h or FFh, then: 1) send an ATA IDLE command to the ATA device with the ATA COUNT field set to the previously saved value of the ATA standby timer (see 10.1.11.2); 2) if the ATA IDLE command completes with any error, then process ending status according to the IMMED bit (see 9.11.2)[b]; 3) if the ATA IDLE command completes without error, then send an ATA verify [a] command (see 3.1.33) to the ATA device with the ATA COUNT set to one and the LBA set to a value between zero and the maximum LBA supported by the ATA device in its current configuration; 4) if the ATA verify command completes with any error, then process ending status according to the IMMED bit (see 9.16.2)[b]; and 5) if the ATA verify command completes without error and the IMMED bit is set to zero, then return GOOD status.
0Bh	FORCE_STANDBY_0	The SATL shall: 1) If ATA IDENTIFY DEVICE data word 49, bit 13 is set to zero or the standby timer is not enabled, then the SATL shall terminate the START STOP UNIT command[c]. 1) if the IMMED bit is set to one, then return GOOD status; 2) if the NO_FLUSH bit is set to zero, then send an ATA flush command (see 3.1.13) to the ATA device; 3) if the ATA flush command in step two completes with an error, then process ending status according to the IMMED bit (see 9.16.2)[b]; 4) if the NO_FLUSH bit is set to one or the ATA flush command in step 2) completes without error, then send an ATA STANDBY IMMEDIATE command to the ATA device; 5) if the ATA STANDBY IMMEDIATE command in step 4) completes with an error, then process ending status according to the IMMED bit (see 9.16.2)[b]; 6) if the ATA STANDBY IMMEDIATE command in step 4) completes without error and the IMMED bit is set to zero, then return GOOD status.

[a] For ATA devices compliant with versions of ATA prior to ACS-2, the ATA device medium access occurs when an LBA is specified whose data is not contained in the ATA device's cache memory. If an LBA value is specified for an ATA verify command where the data is contained in the ATA device's cache memory, then the ATA device may not be in the Active power mode after completion of the ATA verify command.

[b] Process the ending status with the sense key set to ABORTED COMMAND and additional sense code set to COMMAND SEQUENCE ERROR.

[c] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

9.16.2 Processing ending status if an error occurs

If an error occurs during the processing of the START STOP UNIT command and the IMMED bit is set to zero, then the SATL shall terminate the START STOP UNIT command with CHECK CONDITION status with the sense key set and the additional sense code set to the value specified for the error being reported (see table 73, table 74, and table 75).

If an error occurs during the processing of the START STOP UNIT command and the IMMED bit is set to one, then the SATL shall terminate the START STOP UNIT command and return CHECK CONDITION status as a deferred error (see SPC-4) with the sense key and the additional sense code set to the value specified for the error being reported (see table 73, table 74, and table 75).

9.16.3 START STOP UNIT START bit LOEJ bit combinations

The SATL shall perform the actions shown in table 75 in response to a START STOP UNIT command withthe POWER CONDITION field set to zero.

Table 75 — Definition of START and LOEJ bits in the START STOP UNIT CDB (part 1 of 2)

START	LOEJ	Definition
0	0	The SATL shall: 1) if the IMMED bit is set to one, then return GOOD status; 2) if the NO_FLUSH bit is set to zero, then send an ATA flush command (see 3.1.13) to the ATA device; 3) if the ATA flush command in step 2) completes with an error, then process ending status according to the IMMED bit (see 9.16.2) [e]; 4) if the NO_FLUSH bit is set to one or the ATA flush command in step 2) completes without error, then send an ATA STANDBY IMMEDIATE command to the ATA device with the ATA COUNT field set to zero; 5) if the ATA STANDBY IMMEDIATE command in step 4) completes with an error, then process ending status according to the IMMED bit (see 9.16.2) [e]; and 6) if the ATA STANDBY IMMEDIATE command in step 4) completes without error and the IMMED bit is set to zero, then return GOOD status [a].

[a] After returning GOOD status for a START STOP UNIT command with the START bit set to zero, the SATL shall consider the ATA device to be in the Stopped power condition (see SBC-3).

[b] For ATA devices compliant with ACS-2 and older specifications, an ATA device medium access occurs if an LBA is specified whose data is not contained in the ATA device's cache memory. If a value in LBA is specified for the ATA verify command where the data is contained in the ATA device's cache memory, then the ATA device may not be in the Active power mode (see ACS-3) after completion of the ATA verify command.

[c] After returning GOOD status for a START STOP UNIT command with the START bit set to one, the SATL shall consider the ATA device to be in the Active power state (see SBC-3).

[d] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

[e] Process the ending status with the sense key set to ABORTED COMMAND and with the additional sense code set to COMMAND SEQUENCE ERROR.

Table 75 — Definition of START and LOEJ bits in the START STOP UNIT CDB (part 2 of 2)

START	LOEJ	Definition
0	1	If the ATA device supports the Removable Media feature set (see ATA/ATAPI-7), then the SATL shall: 1) if the IMMED bit is set to one, then return GOOD status; 2) send an ATA MEDIA EJECT command to the ATA device; 3) if the ATA MEDIA EJECT command in step 2) completes with an error, then process ending status according to the IMMED bit (see 9.16.2) with the additional sense key set to ABORTED COMMAND and the additional sense code set to MEDIA LOAD OR EJECT FAILED; and 4) if the MEDIA EJECT command in step 2) completes without error and the IMMED bit is set to zero, then return GOOD status. If the ATA device does not support the Removable Media feature set, then the SATL shall terminate the START STOP UNIT command.[d]
1	0	The SATL shall: 1) If the IMMED bit is set to one, then return GOOD status; 2) Send an ATA verify [b] command (see 3.1.33) to the ATA device with the COUNT field set to one and the ATA LBA field set to a value between zero and the maximum LBA supported by the ATA device in its current configuration; and 3) If the IMMED bit is set to zero, then return GOOD status when command completion is received for the ATA verify command (see 3.1.33) [c].
1	1	The SATL shall terminate the START STOP UNIT command [d].

[a] After returning GOOD status for a START STOP UNIT command with the START bit set to zero, the SATL shall consider the ATA device to be in the Stopped power condition (see SBC-3).

[b] For ATA devices compliant with ACS-2 and older specifications, an ATA device medium access occurs if an LBA is specified whose data is not contained in the ATA device's cache memory. If a value in LBA is specified for the ATA verify command where the data is contained in the ATA device's cache memory, then the ATA device may not be in the Active power mode (see ACS-3) after completion of the ATA verify command.

[c] After returning GOOD status for a START STOP UNIT command with the START bit set to one, the SATL shall consider the ATA device to be in the Active power state (see SBC-3).

[d] Command termination is with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

[e] Process the ending status with the sense key set to ABORTED COMMAND and with the additional sense code set to COMMAND SEQUENCE ERROR.

9.16.4 NO_FLUSH translation

The NO_FLUSH bit specifies whether the SATL sends an ATA flush command while processing certain power condition requests (see table 73 and table 74).

9.17 SYNCHRONIZE CACHE (10) command

The SYNCHRONIZE CACHE (10) command is used to flush the most recent data in the cache of the ATA device to physical medium.The SATL shall send an ATA flush command (see)9.1 in accordance with the constraints described in clause 9.1

Table 76 shows the translation for fields in the SYNCHRONIZE CACHE (10) CDB.

Table 76 — SYNCHRONIZE CACHE (10) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 35h.
IMMED	If the IMMED bit is set to one then the SATL shall return GOOD status and then send an ATA flush command (see 3.1.13). If the IMMED bit is set to zero then the SATL shall send an ATA flush command. If the flush command completes without error, the SATL shall return GOOD status for the operation. If the flush command completes with error, the SATL shall return ending status in accordance with clause 11.
LOGICAL BLOCK ADDRESS	The SATL shall ignore this field and shall process this command as though this field contained zero.
GROUP NUMBER	Unspecified (see 3.4.2).
NUMBER OF LOGICAL BLOCKS	The SATL shall ignore this field and shall process this command as though this field contained zero (see SBC-3).
CONTROL	6.5

9.18 SYNCHRONIZE CACHE (16) command

The SYNCHRONIZE CACHE (16) command is used to flush the most recent data in the cache of the ATA device to physical medium. The SATL shall send an ATA flush command (see) in accordance with the constraints described in 9.1.

Table 77 shows the translation for fields in the SYNCHRONIZE CACHE (16) CDB.

Table 77 — SYNCHRONIZE CACHE (16) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 91h.
IMMED	As defined in SYNCHRONIZE CACHE (10) (see 9.17).
LOGICAL BLOCK ADDRESS	As defined in SYNCHRONIZE CACHE (10) (see 9.17).
NUMBER OF LOGICAL BLOCKS	As defined in SYNCHRONIZE CACHE (10) (see 9.17).
GROUP NUMBER	As defined in SYNCHRONIZE CACHE (10) (see 9.17).
CONTROL	6.5

9.19 UNMAP command

9.19.1 UNMAP command overview

The UNMAP command (see table 78) requests the SATL to transfer parameter data from the application client that is used by the SATL to build a set of LBA range entries that are used in a DATA SET MANAGEMENT command to request the specified LBAs to be trimmed.

Table 78 — UNMAP CDB field translations

Field or Bit	Description or Reference
OPERATION CODE	Set to 42h.
ANCHOR	Unspecified (see 3.4.2).
GROUP NUMBER	As defined in WRITE SAME (10) (see 9.33)
PARAMETER LIST LENGTH	If the PARAMETER LIST LENGTH field is set to zero, then the SATL shall process the command as specified in SBC-3. If the PARAMETER LIST LENGTH field is not set to zero and one or more unmap block descriptors are present, then the SATL shall: 1) create ATA LBA range entries that describe all the logical blocks (see 9.1) represented in all the UNMAP block descriptors (see SBC-3) in the UNMAP parameter list using the procedures described in 9.19.2; and 2) issue one or more ATA DATA SET MANAGEMENT commands with the TRIM bit set to one to transfer all the created ATA LBA range entries to the ATA device.
CONTROL	6.5

9.19.2 Creating ATA LBA range entries

The WRITE SAME command specifies a starting LBA and number of logical blocks in CDB fields. The UNMAP command passes a parameter list consisting of one or more UNMAP block descriptors each of which contains a starting LBA and number of logical blocks

ATA LBA range entries specify a starting LBA and number of logical blocks over which a data set management operation is to be performed.

The SATL shall create one or more ATA LBA range entries from the input starting LBA values and number of blocks values as follows:

c) If the SATL implements indirect logical block mapping then, the method of creating ATA LBA range entries is unspecified.
d) If the SATL implements direct logical block mapping (see 3.1.35), then for each input combination of starting LBA and number of blocks, the SATL shall create one or more ATA LBA range entries as follows:
   A) if the number of blocks value is less than 1_0000h, then one ATA LBA range entry (see ACS-3) shall be created with the first six bytes equal to the starting LBA value; and the remaining two bytes equal to the number of blocks, or
   B) if the number of blocks value is greater than FFFFh, then
      1) one ATA LBA range entry (see ACS-2) shall be created with:
         A) the first six bytes equal to the starting LBA value; and
         B) the remaining two bytes equal to FFFFh;
      1) add FFFFh to the starting LBA value;
      2) subtract FFFFh from the number of blocks value; and

3) repeat this algorithm starting at step A).

9.20 VERIFY (10) command

The VERIFY (10) command is used to verify data on the ATA device's medium. Table 79 shows the translation of fields in the VERIFY (10) CDB.

The SATL shall send an ATA verify command (see 3.1.33) or ATA read command (see clause 3.1.27) in accordance with the constraints defined in 9.1.

Table 79 — VERIFY (10) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 2Fh.
VRPROTECT	Unspecified (see 3.4.2).
DPO	Unspecified (see 3.4.2).
BYTCHK	If the SATL supports: e) a BYTCHK field set to 01b and if the BYTCHK field is set to 01b; or f) a BYTCHK field set to 11b and the BYTCHK field is set to 11b, then the SATL shall perform a byte-by-byte comparison of the data transferred from the application client to the SATL with data read from the ATA device using an ATA read command (see 3.1.24) by the SATL, and return completion status reflecting the results of the comparison as described in SBC-3. IIf the BYTCHK field is set to 00b, the SATL shall send an ATA verify command (see 3.1.33) in accordance with the constraints defined in 9.1.
LOGICAL BLOCK ADDRESS	If the SATL implements direct logical block mapping (see 3.1.44), then the SATL shall set the ATA LBA in the ATA verify command (see 3.1.33) or ATA read command (see (see clause 3.1.27) equal to the value specified in the LOGICAL BLOCK ADDRESS field. Otherwise, the mapping is unspecified (see 3.4.2).
GROUP NUMBER	Unspecified (see 3.4.2)
VERIFICATION LENGTH	If the SATL implements direct logical block mapping (see 3.1.44), then the SATL shall set the ATA COUNT (see 3.1.29) in the ATA verify command (see 3.1.33) or ATA read command (see clause 3.1.27) equal to the value specified in the VERIFICATION LENGTH field. Otherwise, the mapping is unspecified (see 3.4.2).
CONTROL	6.5

9.21 VERIFY (12) command

Table 80 shows the translation of fields in the VERIFY (12) CDB

The SATL shall send an ATA verify command (see 3.1.33) or ATA read command (see clause 3.1.27) in accordance with the constraints defined in 9.1.

Table 80 — VERIFY (12) CDB field translations

Field	Description or reference
OPERATION CODE	Set to AFh.
VRPROTECT	As defined in VERIFY (10) (see 9.20).
DPO	As defined in VERIFY (10) (see 9.20).
BYTCHK	As defined in VERIFY (10) (see 9.20).
LOGICAL BLOCK ADDRESS	As defined in VERIFY (10) (see 9.20).
VERIFICATION LENGTH	As defined in VERIFY (10) (see 9.20).
GROUP NUMBER	As defined in VERIFY (10) (see 9.20).
CONTROL	6.5

9.22 VERIFY (16) command

Table 81 shows the translation of fields in the VERIFY (16) CDB

The SATL shall send an ATA verify command (see 3.1.33) or ATA read command (see clause 3.1.27) in accordance with the constraints defined in 9.1.

Table 81 — VERIFY (16) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 8Fh.
VRPROTECT	As defined in VERIFY (10) (see 9.20).
DPO	As defined in VERIFY (10) (see 9.20).
BYTCHK	As defined in VERIFY (10) (see 9.20).
LOGICAL BLOCK ADDRESS	As defined in VERIFY (10) (see 9.20).
VERIFICATION LENGTH	As defined in VERIFY (10) (see 9.20).
GROUP NUMBER	As defined in VERIFY (10) (see 9.20).
CONTROL	6.5

9.23 WRITE commands overview

This subclause applies to the translation of the WRITE(10) command, the WRITE(12) command, and the WRITE(16) command.

If the FUA bit is set to zero in the SCSI write command CDB, then the SATL shall transfer the logical blocks in the SCSI write command (see 3.1.87) from the SCSI application client to the ATA device. The SATL shall send ATA write commands (see 3.1.35) in accordance with the constraints specified in 9.1.

If the FUA bit is set to one in the SCSI write command CDB, then the SATL shall send, in accordance with the constraints described in 9.1:

a) the following ATA commands:
   1) an ATA write command (see 3.1.35) excluding WRITE DMA FUA EXT, WRITE MULTIPLE FUA EXT, and WRITE FPDMA QUEUED; and
   2) an ATA verify command (see 3.1.33);
b) one of the following ATA commands (see ACS-3):
   A) WRITE DMA FUA EXT;
   B) WRITE MULTIPLE FUA EXT;

   or

c) an ATA WRITE FPDMA QUEUED command (see SATA-3.1) with the FUA bit in the DEVICE field set to one.

See 5.4 for a description of multiple command sequence error handling.

9.24 WRITE (10) command

The WRITE (10) command is used to request the SATL to transfer user data from the application client to the ATA device. Data may be written to the medium or to the cache of the ATA device.The write operation shall be performed as specified in 9.23.

Table 82 shows the translation of fields in the WRITE (10) CDB.

Table 82 — WRITE (10) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 2Ah.
WRPROTECT	Unspecified (see 3.4.2)
DPO	Unspecified (see 3.4.2)
FUA	9.23
~~FUA_NV~~	~~The SATL may ignore the FUA_NV bit or the SATL may implement the FUA_NV bit as defined in SBC-3.~~
LOGICAL BLOCK ADDRESS	If the SATL implements direct logical block mapping (see 3.1.44), then the SATL shall set the ATA LBA in the ATA write command (see 3.1.35) equal to the value specified in the LOGICAL BLOCK ADDRESS field. Otherwise, the mapping is unspecified (see 3.4.2).
GROUP NUMBER	Unspecified (see 3.4.2)
TRANSFER LENGTH[a]	If the SATL implements direct logical block mapping (see 3.1.44), then the SATL shall set the ATA COUNT in the ATA write command (see 3.1.35) equal to the value specified in the TRANSFER LENGTH field. Otherwise, the mapping is unspecified (see 3.4.2). The SATL shall send as many ATA write commands (see 3.1.35) as needed to satisfy the transfer length.[a]
CONTROL	6.5

[a] A TRANSFER LENGTH field set to zero specifies that no data transfer shall take place.

9.25 WRITE (12) command

The WRITE (12) command is used to request the SATL to transfer user data from the application client to the ATA device. Data may be written to the medium or to the cache of the ATA device.The write operation shall be performed as specified in 9.23.

Table 83 shows the translation of fields in the WRITE (12) CDB.

Table 83 — WRITE (12) CDB field translations

Field	Description or reference
OPERATION CODE	Set to AAh. See 9.23.
WRPROTECT	As defined in WRITE (10) (see 9.24).
DPO	As defined in WRITE (10) (see 9.24).
FUA	As defined in WRITE (10) (see 9.24).
~~FUA_NV~~	~~As defined in WRITE (10) (see 9.24).~~
LOGICAL BLOCK ADDRESS	As defined in WRITE (10) (see 9.24).
TRANSFER LENGTH[a]	As defined in WRITE (10) (see 9.24).[a]
GROUP NUMBER	As defined in WRITE (10) (see 9.24).
CONTROL	6.5

[a] A TRANSFER LENGTH field set to zero specifies that no data transfer shall take place.

9.26 WRITE (16) command

The WRITE (16) command is used to request the SATL to transfer user data from the application client to the ATA device. Data may be written to the medium or to the cache of the ATA device.The write operation shall be performed as specified in 9.23.

Table 84 shows the translation of fields in the WRITE (16) CDB.

Table 84 — WRITE (16) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 8Ah. See 9.23.
WRPROTECT	As defined in WRITE (10) (see 9.24).
DPO	As defined in WRITE (10) (see 9.24).
FUA	As defined in WRITE (10) (see 9.24).
~~FUA_NV~~	~~As defined in WRITE (10) (see 9.24).~~
LOGICAL BLOCK ADDRESS	As defined in WRITE (10) (see 9.24).
TRANSFER LENGTH [a]	As defined in WRITE (10) (see 9.24).[a]
GROUP NUMBER	As defined in WRITE (10) (see 9.24).
CONTROL	6.5

[a] A TRANSFER LENGTH field set to zero specifies that no data transfer shall take place.

9.27 WRITE AND VERIFY commands overview

This subclause applies to the translation of the WRITE AND VERIFY (10) command, WRITE AND VERIFY (12) command, and WRITE AND VERIFY (16) command.

The SATL shall send:

1) an ATA write command (see 3.1.35) in accordance with the constraints defined in 9.1; and
2) an ATA verify command (see 3.1.33) in accordance with the constraints defined n 9.1.

9.28 WRITE AND VERIFY (10) command

The WRITE AND VERIFY (10) command requests that the SATL to transfer the specified logical blocks from the application client to the ATA device, and then verify that the data was written correctly to the medium of the ATA device The write and verify operations shall be performed as specified in 9.27

Table 85 shows the translation of fields in the WRITE AND VERIFY (10) CDB.

Table 85 — WRITE AND VERIFY (10) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 2Eh.
WRPROTECT	Unspecified (see 3.4.2)
DPO	Unspecified (see 3.4.2)
BYTCHK	If the SATL supports: c) a BYTCHK field set to 01b and if the BYTCHK field is set to 01b; or d) a BYTCHK field set to 11b and the BYTCHK field is set to 11b, then after writing the data to the medium, the SATL shall perform a byte-by-byte comparison of the data transferred from the application client to the SATL with data read from the ATA device using an ATA read command (see 3.1.24), and return completion status reflecting the results of the comparison as described in SBC-3. If the BYTCHK field is set to 00b, the SATL shall send an ATA verify command (see 3.1.33) in accordance with the constraints defined in 9.1.
LOGICAL BLOCK ADDRESS	If the SATL implements direct logical block mapping (see 3.1.44), then the SATL shall set the ATA LBA in the ATA write command (see 3.1.35) and the ATA verify command (see 3.1.33) equal to the value specified in the LOGICAL BLOCK ADDRESS field. Otherwise, the mapping is unspecified (see 3.4.2).
GROUP NUMBER	Unspecified (see 3.4.2)
TRANSFER LENGTH[a]	If the SATL implements direct logical block mapping (see 3.1.44), then the SATL shall set the ATA Sector Count in the ATA write command (see 3.1.35) and the ATA verify command (see 3.1.33) equal to the value specified in the TRANSFER LENGTH field. Otherwise, the mapping is unspecified (see 3.4.2). The SATL shall send as many ATA write commands and ATA verify commands as needed to satisfy the transfer length specified by the WRITE AND VERIFY (10) command.
CONTROL	6.5

[a] A TRANSFER LENGTH field set to zero specifies that a data transfer shall not take place.

9.29 WRITE AND VERIFY (12) command

The WRITE AND VERIFY (12) command requests that the SATL to transfer the specified logical blocks from the application client to the ATA device, and then verify that the data was written correctly to the medium of the ATA device. The write and verify operations shall be done as specified in 9.27.

Table 86 shows the translation of fields in the WRITE AND VERIFY (12) CDB.

Table 86 — WRITE AND VERIFY (12) CDB field translations

Field	Description or reference
OPERATION CODE	Set to AEh.
WRPROTECT	As defined in WRITE AND VERIFY (10) (see 9.28).
DPO	As defined in WRITE AND VERIFY (10) (see 9.28).
BYTCHK	As defined in WRITE AND VERIFY (10) (see 9.28).
LOGICAL BLOCK ADDRESS	As defined in WRITE AND VERIFY (10) (see 9.28).
TRANSFER LENGTH[a]	As defined in WRITE AND VERIFY (10) (see 9.28).
GROUP NUMBER	As defined in WRITE AND VERIFY (10) (see 9.28).
CONTROL	6.5

[a] A TRANSFER LENGTH field set to zero specifies that a data transfer shall not take place.

9.30 WRITE AND VERIFY (16) command

The WRITE AND VERIFY (16) command requests that the SATL to transfer the specified logical blocks from the application client to the ATA device, and then verify that the data was written correctly to the medium of the ATA device. The write and verify operations shall be performed as described in 9.27

Table 87 shows the translation of fields in the WRITE AND VERIFY (16) CDB.

Table 87 — WRITE AND VERIFY (16) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 8Eh.
WRPROTECT	As defined in WRITE AND VERIFY (10) (see 9.28).
DPO	As defined in WRITE AND VERIFY (10) (see 9.28).
BYTCHK	As defined in WRITE AND VERIFY (10) (see 9.28).
LOGICAL BLOCK ADDRESS	As defined in WRITE AND VERIFY (10) (see 9.28).
GROUP NUMBER	As defined in WRITE AND VERIFY (10) (see 9.28).
TRANSFER LENGTH[a]	As defined in WRITE AND VERIFY (10) (see 9.28).
CONTROL	6.5

[a] A TRANSFER LENGTH field set to zero specifies that a data transfer shall not take place.

9.31 WRITE LONG (10) command

The WRITE LONG (10) command (see SBC-3) requests that the SATL mark a logical block or physical block as containing an error. If the ATA device does not support the ATA WRITE UNCORRECTABLE EXT command (see ACS-3), then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID OPERATION CODE.

Table 88 shows the translation of fields in the WRITE LONG (10) CDB.

Table 88 — WRITE LONG (10) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 3Fh.
COR_DIS	See table 89.
WR_UNCOR	See table 89.

Table 88 — WRITE LONG (10) CDB field translations

Field	Description or reference
PBLOCK	See table 89.
LOGICAL BLOCK ADDRESS	If the SATL implements direct block mapping (see 3.1.44), then the SATL shall set the ATA LBA in the ATA WRITE UNCORRECTABLE EXT command equal to the value specified in this field.. Otherwise the mapping is unspecified (see 3.4.2).
BYTE TRANSFER LENGTH	If the BYTE TRANSFER LENGTH field is not set to zero, the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.
CONTROL	6.5

The interaction of the WR_UNCOR bit and the PBLOCK bit are defined in table 89.

Table 89 — WR_UNCOR bit and PBLOCK bit

COR_DIS	WR_UNCOR	PBLOCK	Description
0	1	0	If the ATA logical sectors per physical sector exponent is non-zero, then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB. If the ATA logical sectors per physical sector exponent is zero, then the SATL shall send an ATA WRITE UNCORRECTABLE EXT command with: a) the FEATURE field set to 55h (i.e, pseudo-uncorrectable error with logging); and b) the COUNT field set to 0001h.
0	1	1	The SATL shall send an ATA WRITE UNCORRECTABLE EXT command with: a) the FEATURE field set to 55h (i.e., pseudo-uncorrectable error with logging); and b) the COUNT field set to 0001h.
1	1	0	The SATL shall send an ATA WRITE UNCORRECTABLE EXT command with: a) the FEATURE field set to AAh (i.e., flagged error without logging); and b) the COUNT field set to 0001h.
All others			The SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

9.32 WRITE LONG (16) command

The WRITE LONG (16) command (see SBC-3) requests that the SATL mark a logical block or physical block as containing an error. If the ATA device does not support the ATA WRITE UNCORRECTABLE EXT command (see

ACS-3), then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID OPERATION CODE.

Table 90 shows the translation of fields in the WRITE LONG (16) CDB.

Table 90 — WRITE LONG (16) CDB field translations

Field	Description or reference
OPERATION CODE / SERVICE ACTION	Set to 9Fh / 11h.
COR_DIS	As defined in WRITE LONG (10) (see 9.31)
WR_UNCOR	As defined in WRITE LONG (10) (see 9.31)
PBLOCK	As defined in WRITE LONG (10) (see 9.31)
LOGICAL BLOCK ADDRESS	As defined in WRITE LONG (10) (see 9.31)
BYTE TRANSFER LENGTH	As defined in WRITE LONG (10) (see 9.31)

9.33 WRITE SAME (10) command

The WRITE SAME (10) command requests that the SATL transfer a single logical block from the application client and write the contents of that single logical block to the specified range of LBAs on the ATA device. The SATL shall perform the write same operation as described in 9.34.2 or 9.34.3

Table 91 shows the translations of the fields in the WRITE SAME (10) CDB.

Table 91 — WRITE SAME (10) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 41h
WRPROTECT	Unspecified (see 3.4.2)
ANCHOR	9.34.2
UNMAP	9.34.2

Table 91 — WRITE SAME (10) CDB field translations

Field	Description or reference
LOGICAL BLOCK ADDRESS	If the SATL implements direct logical block mapping (see 3.1.44), then the SATL shall set the START field in the ATA SCT Write Same command or the LBA field in the ATA write command (see 3.1.35) equal to the value specified in the LOGICAL BLOCK ADDRESS field. Otherwise, the mapping is unspecified (see 3.4.2).
GROUP NUMBER	Unspecified (see 3.4.2)
NUMBER OF LOGICAL BLOCKS	A NUMBER OF LOGICAL BLOCKS field set to zero specifies that the SATL shall repeatedly write the logical block transferred from the application client to the range of ATA logical sectors corresponding to the range of LBAs specified by the LOGICAL BLOCK ADDRESS field through the LBA of the last logical block on the logical unit (i.e., the ATA maximum LBA (see 3.1.20)). If the NUMBER OF LOGICAL BLOCKS field is set to a value other than zero, then the SATL shall repeatedly write the data block transferred from the application client to the medium of the ATA device for the number of logical blocks specified to the corresponding logical sectors on the ATA device. The SATL shall send as many ATA commands as required to satisfy the number of blocks specified by the WRITE SAME (10) command.
CONTROL	6.5

9.34 WRITE SAME (16) command

9.34.1 WRITE SAME (16) command overview

The WRITE SAME (16) command (see table 92) requests that the SATL transfer a single logical block from the application client and write the contents of that single logical block to the specified range of LBAs on the ATA device. The SATL shall either perform the ATA DATA SET MANAGEMENT operation as described in 9.34.2, or the write operation as described in 9.34.3, depending upon whether the UNMAP bit is set to 1 or 0, and whether the device supports logical block provisioning.

Table 92 shows the translations of the fields in the WRITE SAME (16) CDB.

Table 92 — WRITE SAME (16) CDB field translations

Field	Description or reference
OPERATION CODE	Set to 93h.
WRPROTECT	As defined in WRITE SAME (10) (see 9.33).
ANCHOR	9.34.2
UNMAP	

Table 92 — WRITE SAME (16) CDB field translations

Field	Description or reference
LOGICAL BLOCK ADDRESS	As defined in WRITE SAME (10) (see 9.33).
NUMBER OF LOGICAL BLOCKS	As defined in WRITE SAME (10) (see 9.33).
GROUP NUMBER	As defined in WRITE SAME (10) (see 9.33).
CONTROL	6.5

9.34.2 ANCHOR bit and UNMAP bit

Table 93 shows the interactions of the UNMAP bit and the ANCHOR bit.

Table 93 — UNMAP bit and ANCHOR bit interactions

UNMAP bit	ANCHOR bit	Description or reference
0b	0b	See 9.34.3
	1b	The SATL shall process the command as defined in SBC-3.
1b	0b	If the LBPRZ bit is set to one in the READ CAPACITY(16) parameter data, and the data block transferred from the application client to the SATL for the WRITE SAME command contains all bits set to zero then: 3) if the NUMBER OF BLOCKS field is set to zero, then the SATL shall create ATA LBA range entries (see ACS-3) that describe logical blocks from the specified LBA to the highest numbered LBA in the ATA user data area (see ACS-3) as described in 9.19.2; 4) if the NUMBER OF BLOCKS field is not set to zero, then the SATL shall create ATA LBA range entries that describe the logical blocks represented by the LOGICAL BLOCK ADDRESS field and the NUMBER OF BLOCKS field as described in 9.19.2; and 5) issue one or more ATA DATA SET MANAGEMENT commands with the TRIM bit set to one to transfer all the created ATA LBA range entries to the ATA device. Otherwise the SATL shall write as described in 9.34.3.
	1b	If the LBPE bit is set to zero in the READ CAPACITY(16) parameter data, then the SATL shall process the command as defined in SBC-3. If the LBPE bit is set to one then: a) if the LBPRZ bit is set to one in the READ CAPACITY(16) parameter data and the data block transferred from the application client to the SATL for the WRITE SAME command contains all bits set to zero, then: 1) if the NUMBER OF BLOCKS field is set to zero, then the SATL shall create ATA LBA range entries (see ACS-3) that describe logical blocks from the specified LBA to the highest numbered LBA in the ATA user data area (see ACS-3) as described in 9.19.2; 2) if the NUMBER OF BLOCKS field is not set to zero, then the SATL shall create ATA LBA range entries that describe the logical blocks represented by the LOGICAL BLOCK ADDRESS field and the NUMBER OF BLOCKS field as described in 9.19.2; and 3) issue one or more ATA DATA SET MANAGEMENT commands with the TRIM bit set to one; b) otherwise the SATL shall write as described in 9.34.3.

9.34.3 Writing the data block

The SATL shall write the block of data transferred from the application client to the range of blocks specified in the LOGICAL BLOCK ADDRESS field and the NUMBER OF LOGICAL BLOCKS field, repeatedly, on the medium of the ATA device.

If the ATA device supports the ATA SCT Write Same command, then the SATL should use the ATA SCT Write Same command with:

a) the FUNCTION CODE field set to 0102h for writing the data;
b) the COUNT field of the SCT Write Same key page set to the value of the NUMBER OF LOGICAL BLOCKS field; and
c) the START field of the SCT Write Same key page set to the value specified in the LOGICAL BLOCK ADDRESS field.

If the ATA device does not support the ATA SCT Write Same command, then the SATL shall use ATA write commands as defined in 9.23 .

10 Parameters for SAT implementations

10.1 Mode parameters

10.1.1 General information

SCSI mode parameters provide a mechanism to set operating parameters for SCSI devices and logical units. The MODE SENSE command obtains operating parameters and the MODE SELECT command sets operating parameters. This standard does not define the content of most operating parameters defined in mode pages due to lack of equivalent operations or features defined for ATA devices. The SATL emulates a SCSI device server for all MODE SENSE and MODE SELECT commands, and shall emulate the mode pages listed in 10.1.3.

The Mode Page Policy VPD page (see clause 10.3) should be implemented. If implemented, then the MODE PAGE POLICY field in each mode page policy descriptor should be set to 00b (i.e., shared) for each mode page and only one copy of mode page values should be maintained for all logical units within a target device (i.e., the MLUS bit is set to one in each mode page policy descriptor).

If the Mode Page Policy VPD page is not implemented, then the SATL shall maintain shared mode pages for all I_T nexuses and shall share mode pages across all logical units within a target device.

10.1.2 Common mode page structures

Clause 10.1.4 describes the format of mode parameter headers used for all pages.

Clause 10.1.5 describes the format of the optional mode parameter block descriptors used for all mode pages.

10.1.3 Commonly used SCSI mode pages overview

This standard defines translations for the mode pages listed in table 94.

Table 94 — Summary of SCSI / ATA mode page mapping

SCSI mode page	Reference
Control (i.e., 0Ah)	10.1.6
Control Extension (i.e., 0Ah/01h)	10.1.7
Read-Write Error Recovery (i.e., 01h)	10.1.8
Caching (i.e., 08h)	10.1.9
Informational Exceptions Control (i.e., 1Ch)	10.1.10
ATA Power Condition (i.e.,1Ah)	10.2
All others	Unspecified (see 3.4.2)

10.1.4 Mode parameter headers

Table 95 shows the fields in the mode parameter header for the MODE SELECT (6) command and the MODE SENSE (6) command.

Table 95 — Mode parameter header (6) fields

Field	Description or reference
MODE DATA LENGTH	Unspecified (see 3.4.2)
MEDIUM TYPE	This field should be set to 00h for MODE SENSE commands. When processing a MODE SELECT command, if the MEDIUM TYPE field is set to a value other than 00h, then the SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.
DEVICE SPECIFIC PARAMETER	Unspecified (see 3.4.2) for the MODE SELECT command. For the MODE SENSE command, the DEVICE SPECIFIC PARAMETER field for direct-access block devices contains the DPOFUA bit and the WP bit (see SBC-3). A DPOFUA bit set to zero indicates that the SATL supports neither the DPO bit nor the FUA bit. A DPOFUA bit set to one indicates that the SATL supports both the DPO bit and the FUA bit. A WP bit set to zero indicates that the medium is not write-protected. A WP bit set to one indicates that the medium is write-protected.
BLOCK DESCRIPTOR LENGTH	This value is obtained by multiplying the number of block descriptors by eight (see SPC-4). The SATL shall support zero or one mode parameter block descriptors.

Table 96 shows the fields in the mode parameter header for the MODE SELECT (10) command and the MODE SENSE (10) command.

Table 96 — Mode parameter header (10) fields

Field	Description or reference
MODE DATA LENGTH	Table 95

Table 96 — Mode parameter header (10) fields

Field	Description or reference
MEDIUM TYPE	Table 95
DEVICE SPECIFIC PARAMETER	Table 95
LONGLBA	Describes the length of the block descriptors as follows: a) If set to zero, then the mode parameter block descriptor is eight bytes long; or b) If set to one, then the mode parameter block descriptor is 16 bytes long.
BLOCK DESCRIPTOR LENGTH	This field specifies (i.e., for a MODE SELECT command) or indicates (i.e., for a MODE SENSE command) the length of the mode parameter block descriptor. This value is obtained by multiplying the number of block descriptors by eight if LONGLBA bit is set to zero or by 16 if LONGLBA bit is set to one. The SATL shall support zero or one mode parameter block descriptors.

10.1.5 Mode parameter block descriptor fields

The SATL may support the direct-access short LBA mode parameter block descriptor or the long LBA mode parameter block descriptor. Table 97 describes the translation of fields in the short LBA mode parameter block descriptor and the long LBA mode parameter block descriptor supported by the SATL.

Table 97 — Mode parameter block descriptor fields

Field	Description or reference
NUMBER OF BLOCKS [a]	Unspecified (see 3.4.2)
BLOCK LENGTH [a]	If processing a MODE SELECT command, if the SATL implements direct logical block mapping (see 3.1.44), and the value of the BLOCK LENGTH field is not the same as the ATA logical sector size (see 3.1.19), then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST. If the SATL supports indirect logical block mapping then this field is unspecified (see 3.4.2). If processing the MODE SENSE command, and if the SATL implements direct logical block mapping (see 3.1.44) then the SATL shall return the same block length for the entire logical unit and the BLOCK LENGTH field shall contain the ATA logical sector size (see 3.1.19). Otherwise the BLOCK LENGTH field is unspecified (see 3.4.2).

[a] The values reported in the NUMBER OF BLOCKS field and the BLOCK LENGTH field shall be such that the logical unit capacity (see 3.1.58) is less than or equal to the ATA device capacity (see 3.1.10).

10.1.6 Control mode page

10.1.6.1 General translation

The Control mode page provides controls and information about behavior of the emulated SCSI device.

Table 98 describes the translation of the Control mode page for an ATA device.

Table 98 — Control mode page fields (part 1 of 3)

Field	Changeable	Description or reference
PS	n/a	Unspecified (see 3.4.2)
SPF	no	Shall be set to zero.
PAGE CODE	no	Shall be set to 0Ah.

[a] SATL implementations shall not support ACA.
[b] SATLs compliant with SAT return descriptor format sense data for the ATA PASS-THROUGH commands regardless of the value of the D_SENSE bit.

Table 98 — Control mode page fields (part 2 of 3)

Field	Changeable	Description or reference
PAGE LENGTH	no	Shall be set to 0Ah.
TST	no	Shall be set to 000b to indicate that a SCSI representation of an ATA device has one task set for all initiators
TMF_ONLY	no	Shall be set to zero [a]
DPICZ	Unspecified	Unspecified (see 3.4.2)
D_SENSE	Unspecified	The SATL shall support this bit as defined in SPC-4 with the following exception: a) if the D_SENSE bit is set to zero (i.e., fixed format sense data), the SATL should return fixed format sense data for ATA PASS-THROUGH commands. [b]
GLTSD	Unspecified	Unspecified (see 3.4.2)
RLEC	no	Shall be set to zero
QUEUE ALGORITHM MODIFIER	no	Shall be set to one.
NUAR	Unspecified	Unspecified(see 3.4.2)
QERR	no	If the SATL supports the full task management model and ATA abort retry (see 3.1.7) of ATA queued commands (see 3.1.25) aborted by ATA collateral abort (see 6.2.6), then the SATL shall set this field to 00b. Otherwise, the SATL shall set this field to 01b and comply with the unit attention condition requirements for a command completed with CHECK CONDITION status (see SPC-4).
RAC	Unspecified	Unspecified (see 3.4.2)
UA_INTLCK_CTRL	no	Shall be set to 00b
SWP	no	Shall be set to zero
ATO	Unspecified	Unspecified (see 3.4.2)
TAS	no	Shall be set to zero
ATMPE	Unspecified	Unspecified (see 3.4.2)

[a] SATL implementations shall not support ACA.
[b] SATLs compliant with SAT return descriptor format sense data for the ATA PASS-THROUGH commands regardless of the value of the D_SENSE bit.

Table 98 — Control mode page fields (part 3 of 3)

Field	Changeable	Description or reference
RWWP	Unspecified	Unspecified (see 3.4.2)
AUTOLOAD MODE	no	Shall be set to 000b
BUSY TIMEOUT PERIOD	Unspecified	The default value shall be set to FFFFh. A SATL may support variable timeout periods and allow the application client to set a new value through a MODE SELECT operation for this mode page (see SPC-4).
EXTENDED SELF-TEST COMPLETION TIME	no	10.1.6.2

[a] SATL implementations shall not support ACA.
[b] SATLs compliant with SAT return descriptor format sense data for the ATA PASS-THROUGH commands regardless of the value of the D_SENSE bit.

10.1.6.2 Extended self-test completion time

A SATL implementation shall set the EXTENDED SELF-TEST COMPLETION TIME field to 0000h unless the ATA device supports SMART self-tests and the SATL supports a value other than 000b for the SELF-TEST CODE field for a SEND DIAGNOSTIC command. The SATL determines if the ATA device supports SMART self-test by examining the value of the ATA IDENTIFY DEVICE data log SMART SELF-TEST SUPPORTED bit. If the ATA IDENTIFY DEVICE data logSMART SELF-TEST SUPPORTED bit is set to one, then the ATA device supports the SMART self-test and shall retrieve the ATA device SMART data structure from the ATA device by sending an ATA SMART READ DATA command to the ATA device. The SATL may cache the ATA SMART READ data for future use when a subsequent MODE SENSE command requests the Control mode page. If the SATL caches such data, the SATL may reference the cached copy instead of sending a new ATA SMART READ DATA command. The SATL shall set the EXTENDED SELF-TEST COMPLETION TIME field as follows:

1) If byte 373 of the returned SMART data structure is not set to FFh, then the SATL shall set the EXTENDED SELF-TEST COMPLETION TIME field to a value that is 60 times the contents of byte 373; or
2) If byte 373 of the returned SMART data structure is set to FFh, then the SATL shall set the EXTENDED SELF-TEST COMPLETION TIME field to a value that is the lesser of FFFFh or the result of the following formula:

EXTENDED SELF-TEST COMPLETION TIME field = ((w x 256) + z) x 60

where:

w is the contents of byte 376; and

z is the contents of byte 375.

10.1.7 Control Extension mode page

The Control Extension mode page provides extended controls and information about behavior of the emulated SCSI device.

Table 99 defines the translation of the fields of the Control Extension mode page.

Table 99 — Control Extension mode page field translation

Field	Changeable	Description or Reference
PS	n/a	Unspecified (see 3.4.2)
SPF	no	Shall be set to one
PAGE CODE	no	Shall be set to 0Ah
SUBPAGE CODE	no	Shall be set to 01h
PAGE LENGTH	no	Shall be set to 1Ch
TCMOS	yes	Unspecified (see 3.4.2)
SCSIP	yes	Unspecified (see 3.4.2)
IALUAE	no	Shall be set to zero
INITIAL COMMAND PRIORITY	n/a	Unspecified (see 3.4.2)
MAXIMUM SENSE DATA LENGTH	Unspecified	Unspecified (see 3.4.2)

10.1.8 Read-Write Error Recovery mode page

The Read-Write Error Recovery mode page specifies the error recovery parameters the SATL shall use during a command that performs a read or write operation to the medium of the ATA device (see SBC-3). Table 100 defines the translation for the Read-Write Error Recovery mode page.

Table 100 — Read-Write Error Recovery mode page fields

Field	Changeable	Description or reference
PS	n/a	Unspecified (see 3.4.2)
SPF	no	Shall be set to zero
PAGE CODE	no	Shall be set to 01h
PAGE LENGTH	no	Shall be set to 0Ah
AWRE	no	Shall be set to one
ARRE	no	Shall be set to zero
TB	n/a	Unspecified (see 3.4.2)
RC	no	Shall be set to zero
EER	no	Shall be set to zero
PER	no	Shall be set to zero
DTE	no	Shall be set to zero
DCR	no	Shall be set to zero
READ RETRY COUNT	n/a	Unspecified (see 3.4.2)
LBPERE	n/a	Unspecified (see 3.4.2)
WRITE RETRY COUNT	n/a	Unspecified (see 3.4.2)
RECOVERY TIME LIMIT	no	Shall be set to zero

10.1.9 Caching mode page

The Caching mode page defines parameters that affect the behavior of the cache in the ATA device.

Table 101 shows the translation of fields in the Caching mode page.

Table 101 — Caching mode page fields (part 1 of 2)

Field	Changeable	Description or reference
PS	n/a	Unspecified (see 3.4.2)
SPF	no	Shall be set to zero
PAGE CODE	no	Shall be set to 08h
PAGE LENGTH	no	Shall be set to 12h
IC	no	Shall be set to zero
ABPF	no	Shall be set to zero
CAP	no	Shall be set to zero
DISC	no	Shall be set to zero
SIZE	no	Shall be set to zero
WCE	yes [a]	If processing a MODE SENSE command, the SATL shall determine if the write cache of the ATA device is enabled from the ATA IDENTIFY DEVICE data log VOLATILE WRITE CACHE ENABLED bit. If the write cache of the ATA device is enabled then the SATL shall return a value of one for the WCE bit. If the write cache of the ATA device is disabled then the SATL shall return a value of zero for the WCE bit. if processing a MODE SELECT command and: a) the WCE bit is set to zero, then the SATL shall disable the write cache of the ATA device by issuing an ATA SET FEATURES – Disable write cache command (i.e., with the FEATURE field set to 82h); or b) the WCE bit is set to one, then the SATL shall enable the write cache of the ATA device by issuing an ATA SET FEATURES – Enable write cache command (i.e., with the FEATURE field set to 02h).
MF	no	Shall be set to zero
RCD	no	Shall be set to zero
DEMAND READ RETENTION PRIORITY	no	Shall be set to zero

[a] If the ATA device does not support a write cache (i.e., ATA IDENTIFY DEVICE data log VOLATILE WRITE CACHE SUPPORTED bit is set to zero), this field is not changeable.

Table 101 — Caching mode page fields (part 2 of 2)

Field	Changeable	Description or reference
WRITE RETENTION PRIORITY	no	Shall be set to zero
DISABLE PRE-FETCH TRANSFER LENGTH	no	Shall be set to zero
MINIMUM PRE-FETCH	no	Shall be set to zero
MAXIMUM PRE-FETCH	no	Shall be set to zero
MAXIMUM PRE-FETCH CEILING	no	Shall be set to zero
FSW	no	Shall be set to zero
LBCSS	no	Shall be set to zero
DRA	yes	If processing a MODE SENSE command, the SATL shall determine if the ATA device look-ahead is enabled from the ATA IDENTIFY DEVICE data log READ LOOK-AHEAD ENABLED bit If the look-ahead is enabled then the SATL shall return a value of zero for the DRA bit. If the look-ahead is disabled then the SATL shall return a value of one for the DRA bit. If processing a MODE SELECT command and: a) the DRA bit is set to zero, the SATL shall enable the ATA device read look-ahead feature by issuing an ATA SET FEATURES – Enable read look-ahead feature command (i.e., with the FEATURE field set to AAh); or b) the DRA bit is set to one, the SATL shall disable the ATA device read look-ahead feature by issuing an ATA SET FEATURES – Disable read look-ahead feature command (i.e., with the FEATURE field set to 55h).
NV_DIS	no	Shall be set to zero
NUMBER OF CACHE SEGMENTS	no	Shall be set to zero
CACHE SEGMENT SIZE	no	Shall be set to zero

[a] If the ATA device does not support a write cache (i.e., ATA IDENTIFY DEVICE data log VOLATILE WRITE CACHE SUPPORTED bit is set to zero), this field is not changeable.

10.1.10 Informational Exceptions Control mode page

10.1.10.1 Informational Exceptions Control mode page overview

The Informational Exceptions Control mode page defines the methods used by the SATL to control the reporting and the operations of specific informational exception conditions. The Informational Exceptions Control mode page applies to informational exceptions that return an additional sense code of FAILURE PREDICTION THRESHOLD EXCEEDED or WARNING to the application client (see SBC-3).

The SATL shall determine if the ATA SMART feature set is supported from the ATA IDENTIFY DEVICE data log SMART bit. If the ATA SMART feature set is not supported, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB for a MODE SENSE command or INVALID FIELD IN PARAMETER LIST for a MODE SELECT command.

Table 102 shows the translation of fields in the Informational Exceptions Control mode page.

Table 102 — Informational Exceptions Control mode page fields

Field	Changeable	Description or reference
PS	n/a	Unspecified (see 3.4.2)
SPF	no	Shall be set to zero
PAGE CODE	no	Shall be set to 1Ch.
PAGE LENGTH	no	Shall be set to 0Ah
PERF	no	Shall be set to zero
EBF	n/a	Unspecified (see 3.4.2)
EWASC	n/a	Unspecified (see 3.4.2)
DEXCPT	yes	Unspecified (see 3.4.2)
TEST	no	Shall be set to zero
EBACKERR	no	Unspecified (see 3.4.2)
LOGERR	n/a	Unspecified (see 3.4.2)
MRIE	Unspecified [a]	Should be set to 6h (see 10.1.10.2).
INTERVAL TIMER	n/a	Unspecified (see 3.4.2)
REPORT COUNT	n/a	Unspecified (see 3.4.2)

[a] The MRIE field should be set to 6h; however, if the SATL supports other settings of the MRIE field, then the SATL should permit the MRIE field to be changeable.

10.1.10.2 Method of reporting informational exceptions (MRIE)

The SATL should support 6h. Support for any other value is unspecified (see 3.4.2).

If the MRIE field is set to 6h and the SATL receives a REQUEST SENSE command, the SATL shall send an ATA SMART RETURN STATUS command to the ATA device and return status to the application client as defined in SPC-4 (see 10.2.6.2). If the result of the ATA SMART RETURN STATUS command indicates a threshold exceeded condition, then the SATL shall set the additional sense code to HARDWARE IMPENDING FAILURE GENERAL HARD DRIVE FAILURE.

10.1.11 Power condition mode pages

10.1.11.1 Power condition mode pages overview

The Power condition mode pages allow setting and examining of:

a) the ATA APM mode setting using the ATA specific ATA Power Condition mode page (see 12.3.3);
b) the ATA power management timers (see 10.1.11.2); and
c) the ATA extended power condition settings (see 10.1.11.2).

10.1.11.2 Power condition mode page

10.1.11.2.1 Introduction to Power condition mode page

The Power condition mode page translation allows setting and examining the ATA STANDBY timer value and other ATA idle and ATA standby timers, if they are supported (see ACS-3). If the ATA EPC SUPPORTED bit is:

a) set to one, then the Power condition mode page translation is defined in 10.1.11.2.2; or
b) set to zero, then the Power condition mode page translation is defined in 10.1.11.2.3.

10.1.11.2.2 Power condition mode page processing if ATA EPC is supported

10.1.11.2.2.1 Summary of ATA EPC supported processing

If the ATA device supports EPC (i.e., if the ATA EPC SUPPORTED bit is set to one), SATL processing for the Power condition mode page is defined in Table 103.

Table 103 — Power condition mode page fields with ATA EPC supported (part 1 of 5)

Field	Changeable	Description or Reference
PS	n/a	Unspecified (see 3.4.2)
SPF	no	Shall be set to zero
PAGE CODE	no	Shall be set to 1Ah
PAGE LENGTH	no	Shall be set to 26h
PM_BG_ PRECEDENCE	n/a	Unspecified (see 3.4.2)

Table 103 — Power condition mode page fields with ATA EPC supported (part 2 of 5)

Field	Changeable	Description or Reference
IDLE_A bit and IDLE_A CONDITION TIMER field	see 10.1.11.2.2.3	While processing a MODE SENSE command, the SATL shall use the contents of the page control (PC) field to set the IDLE_A bit and the IDLE_A CONDITION TIMER field to the values from the ATA fields shown in Table 108 for the Idle_a power conditions descriptor in the Idle page of the ATA Power Conditions log (see 10.1.11.2.2.2). While processing a MODE SELECT command, the SATL shall: 1) if the ATA Power Conditions log indicates that the IDLE_A bit and the IDLE_A CONDITION TIMER field are not changeable (see 10.1.11.2.2.3), then: A) if the value of the IDLE_A bit is equal to the value of the CURRENT TIMER ENABLED bit in the Idle_a power conditions descriptor in the Idle page of the ATA Power Conditions log, then the SATL shall take no further action for the IDLE_A bit and the IDLE_A CONDITION TIMER field; or B) if the value of the IDLE_A bit is not equal to the value of the CURRENT TIMER ENABLED bit in the Idle_a power conditions descriptor in the Idle page of the ATA Power Conditions log, then the MODE SELECT command shall be terminated as described in 10.1.11.2.4.2; and 2) if the ATA Power Conditions log indicates that the IDLE_A bit and the IDLE_A CONDITION TIMER field are changeable (see 10.1.11.2.2.3), then the SATL shall use the method described in 10.1.11.2.2.4 to modify the contents of the ATA Power Conditions log based on the contents of the IDLE_A bit and the IDLE_A CONDITION TIMER field.
IDLE_B bit and IDLE_B CONDITION TIMER field	see 10.1.11.2.2.3	While processing a MODE SENSE command, the SATL shall use the contents of the page control (PC) field to set the IDLE_B bit and the IDLE_B CONDITION TIMER field to the values from the ATA fields shown in table 104 for the Idle_b power conditions descriptor in the Idle page of the ATA Power Conditions log (see 10.1.11.2.2.2). While processing a MODE SELECT command, the SATL shall: 1) if the ATA Power Conditions log indicates that the IDLE_B bit and the IDLE_B CONDITION TIMER field are not changeable (see 10.1.11.2.2.3), then: A) if the value of the IDLE_B bit is equal to the value of the CURRENT TIMER ENABLED bit in the Idle_b power conditions descriptor in the Idle page of the ATA Power Conditions log, then the SATL shall take no further action for the IDLE_B bit and the IDLE_B CONDITION TIMER field; or B) if the value of the IDLE_B bit is not equal to the value of the CURRENT TIMER ENABLED bit in the Idle_b power conditions descriptor in the Idle page of the ATA Power Conditions log, then the MODE SELECT command shall be terminated as described in 10.1.11.2.4.2; and 2) if the ATA Power Conditions log indicates that the IDLE_B bit and the IDLE_B CONDITION TIMER field are changeable (see 10.1.11.2.2.3), then the SATL shall use the method described in 10.1.11.2.2.4 to modify the contents of the ATA Power Conditions log based on the contents of the IDLE_B bit and the IDLE_B CONDITION TIMER field.

Table 103 — Power condition mode page fields with ATA EPC supported (part 3 of 5)

Field	Changeable	Description or Reference
IDLE_C bit and IDLE_C CONDITION TIMER field	see 10.1.11.2.2.3	While processing a MODE SENSE command, the SATL shall use the contents of the page control (PC) field to set the IDLE_C bit and the IDLE_C CONDITION TIMER field to the values from the ATA fields shown in table 104 for the Idle_c power conditions descriptor in the Idle page of the ATA Power Conditions log (see 10.1.11.2.2.2). While processing a MODE SELECT command, the SATL shall: 1) if the ATA Power Conditions log indicates that the IDLE_C bit and the IDLE_C CONDITION TIMER field are not changeable (see 10.1.11.2.2.3), then: A) if the value of the IDLE_C bit is equal to the value of the CURRENT TIMER ENABLED bit in the Idle_c power conditions descriptor in the Idle page of the ATA Power Conditions log, then the SATL shall take no further action for the IDLE_C bit and the IDLE_C CONDITION TIMER field; or B) if the value of the IDLE_C bit is not equal to the value of the CURRENT TIMER ENABLED bit in the Idle_c power conditions descriptor in the Idle page of the ATA Power Conditions log, then the MODE SELECT command shall be terminated as described in 10.1.11.2.4.2; and 2) if the ATA Power Conditions log indicates that the IDLE_C bit and the IDLE_C CONDITION TIMER field are changeable (see 10.1.11.2.2.3), then the SATL shall use the method described in 10.1.11.2.2.4 to modify the contents of the ATA Power Conditions log based on the contents of the IDLE_C bit and the IDLE_C CONDITION TIMER field.

Table 103 — Power condition mode page fields with ATA EPC supported (part 4 of 5)

Field	Changeable	Description or Reference
STANDBY_Y bit and STANDBY_Y CONDITION TIMER field	see 10.1.11.2.2.3	While processing a MODE SENSE command, the SATL shall use the contents of the page control (PC) field to set the STANDBY_Y bit and the STANDBY_Y CONDITION TIMER field to the values from the ATA fields shown in table 104 for the Standby_y power conditions descriptor in the Standby page of the ATA Power Conditions log (see 10.1.11.2.2.2). While processing a MODE SELECT command, the SATL shall: 1) if the ATA Power Conditions log indicates that the STANDBY_Y bit and the STANDBY_Y CONDITION TIMER field are not changeable (see 10.1.11.2.2.3), then: A) if the value of the STANDBY_Y bit is equal to the value of the CURRENT TIMER ENABLED bit in the Standby_y power conditions descriptor in the Standby page of the ATA Power Conditions log, then the SATL shall take no further action for the STANDBY_Y bit and the STANDBY_Y CONDITION TIMER field; or B) if the value of the STANDBY_Y bit is not equal to the value of the CURRENT TIMER ENABLED bit in the Standby_y power conditions descriptor in the Standby page of the ATA Power Conditions log, then the MODE SELECT command shall be terminated as described in 10.1.11.2.4.2; and 2) if the ATA Power Conditions log indicates that the STANDBY_Y bit and the STANDBY_Y CONDITION TIMER field are changeable (see 10.1.11.2.2.3), then the SATL shall use the method described in 10.1.11.2.2.4 to modify the contents of the ATA Power Conditions log based on the contents of the STANDBY_Y bit and the STANDBY_Y CONDITION TIMER field.

Table 103 — Power condition mode page fields with ATA EPC supported (part 5 of 5)

Field	Changeable	Description or Reference
STANDBY_Z bit and STANDBY_Z CONDITION TIMER field	see 10.1.11.2.2.3	While processing a MODE SENSE command, the SATL shall use the contents of the page control (PC) field to set the STANDBY_Z bit and the STANDBY_Z CONDITION TIMER field to the values from the ATA fields shown in table 104 for the Standby_z power conditions descriptor in the Standby page of the ATA Power Conditions log (see 10.1.11.2.2.2). While processing a MODE SELECT command, the SATL shall: 1) if the ATA Power Conditions log indicates that the STANDBY_Z bit and the STANDBY_Z CONDITION TIMER field are not changeable (see 10.1.11.2.2.3), then: A) if the value of the STANDBY_Z bit is equal to the value of the CURRENT TIMER ENABLED bit in the Standby_z power conditions descriptor in the Standby page of the ATA Power Conditions log, then the SATL shall take no further action for the STANDBY_Y bit and the STANDBY_Y CONDITION TIMER field; or B) if the value of the STANDBY_Z bit is not equal to the value of the CURRENT TIMER ENABLED bit in the Standby_z power conditions descriptor in the Standby page of the ATA Power Conditions log, then the MODE SELECT command shall be terminated as described in 10.1.11.2.4.2; and 2) if the ATA Power Conditions log indicates that the STANDBY_Z bit and the STANDBY_Z CONDITION TIMER field are changeable (see 10.1.11.2.2.3), then the SATL shall use the method described in 10.1.11.2.2.4 to modify the contents of the ATA Power Conditions log based on the contents of the STANDBY_Z bit and the STANDBY_Z CONDITION TIMER field.
CCF IDLE	n/a	Unspecified (see 3.4.2)
CCF STANDBY	n/a	Unspecified (see 3.4.2)
CCF STOPPED	n/a	Unspecified (see 3.4.2)

10.1.11.2.2.2 Field relationships between the ATA Power Conditions log and SCSI MODE SENSE command Power condition mode page

For the ATA EPC feature set, the ATA Power Conditions log contains separate pages for Idle power conditions and Standby power conditions and each page contains power conditions descriptors. The SCSI Power condition mode page contains fields for each power condition and changeable bits that if returned by a MODE SENSE command indicate which fields the application client is allowed to modify.

The MODE SENSE command relationships between these differing ways of representing equivalent information are shown in table 104.

Table 104 — MODE SENSE command Power condition page field relationships (part 1 of 2)

ATA Power Conditions log			SCSI Power condition mode page field
Log page	**Power conditions descriptor**	**Field**	
MODE SENSE command page control (pc) field set to 00b (i.e., current values)			
Idle	Idle_a	CURRENT TIMER ENABLED bit	IDLE_A bit
		CURRENT TIMER SETTING field	IDLE_A CONDITION TIMER field
	Idle_b	CURRENT TIMER ENABLED bit	IDLE_B bit
		CURRENT TIMER SETTING field	IDLE_B CONDITION TIMER field
	Idle_c	CURRENT TIMER ENABLED bit	IDLE_C bit
		CURRENT TIMER SETTING field	IDLE_C CONDITION TIMER field
Standby	Standby_y	CURRENT TIMER ENABLED bit	STANDBY_Y bit
		CURRENT TIMER SETTING field	STANDBY_Y CONDITION TIMER field
	Standby_z	CURRENT TIMER ENABLED bit	STANDBY_Z bit
		CURRENT TIMER SETTING field	STANDBY_Z CONDITION TIMER field
MODE SENSE command page control (pc) field set to 01b (i.e., changeable values)			
Idle	Idle_a	POWER CONDITION CHANGEABLE bit	IDLE_A bit and IDLE_A CONDITION TIMER field [a]
	Idle_b	POWER CONDITION CHANGEABLE bit	IDLE_B bit and IDLE_B CONDITION TIMER field [a]
	Idle_c	POWER CONDITION CHANGEABLE bit	IDLE_C bit and IDLE_C CONDITION TIMER field [a]
Standby	Standby_y	POWER CONDITION CHANGEABLE bit	STANDBY_Y bit and STANDBY_Y CONDITION TIMER field [a]
	Standby_z	POWER CONDITION CHANGEABLE bit	STANDBY_Z bit and STANDBY_Z CONDITION TIMER field [a]

[a] The value of the POWER CONDITION CHANGEABLE bit is replicated in all bits in this field.

Table 104 — MODE SENSE command Power condition page field relationships (part 2 of 2)

ATA Power Conditions log			SCSI Power condition mode page field
Log page	**Power conditions descriptor**	**Field**	
MODE SENSE command page control (pc) field set to 10b (i.e., default values)			
Idle	Idle_a	DEFAULT TIMER ENABLED bit	IDLE_A bit
		DEFAULT TIMER SETTING field	IDLE_A CONDITION TIMER field
	Idle_b	DEFAULT TIMER ENABLED bit	IDLE_B bit
		DEFAULT TIMER SETTING field	IDLE_B CONDITION TIMER field
	Idle_c	DEFAULT TIMER ENABLED bit	IDLE_C bit
		DEFAULT TIMER SETTING field	IDLE_C CONDITION TIMER field
Standby	Standby_y	DEFAULT TIMER ENABLED bit	STANDBY_Y bit
		DEFAULT TIMER SETTING field	STANDBY_Y CONDITION TIMER field
	Standby_z	DEFAULT TIMER ENABLED bit	STANDBY_Z bit
		DEFAULT TIMER SETTING field	STANDBY_Z CONDITION TIMER field
MODE SENSE command page control (pc) field set to 11b (i.e., saved values)			
Idle	Idle_a	SAVED TIMER ENABLED bit	IDLE_A bit
		SAVED TIMER SETTING field	IDLE_A CONDITION TIMER field
	Idle_b	SAVED TIMER ENABLED bit	IDLE_B bit
		SAVED TIMER SETTING field	IDLE_B CONDITION TIMER field
	Idle_c	SAVED TIMER ENABLED bit	IDLE_C bit
		SAVED TIMER SETTING field	IDLE_C CONDITION TIMER field
Standby	Standby_y	SAVED TIMER ENABLED bit	STANDBY_Y bit
		SAVED TIMER SETTING field	STANDBY_Y CONDITION TIMER field
	Standby_z	SAVED TIMER ENABLED bit	STANDBY_Z bit
		SAVED TIMER SETTING field	STANDBY_Z CONDITION TIMER field

[a] The value of the POWER CONDITION CHANGEABLE bit is replicated in all bits in this field.

10.1.11.2.2.3 Changeable field processing

If the ATA POWER CONDITION CHANGEABLE bit associated with a Power condition mode page field (see table 105) is:

a) set to zero, then the Power condition mode page fields are not changeable; or

b) set to one, then the Power condition mode page fields are changeable.

The relationships between the ability to change SCSI Power condition mode page fields and the associated ATA POWER CONDITION CHANGEABLE bits is shown in table 105.

Table 105 — Changeable Power condition mode page associations with ATA POWER CONDITION CHANGEABLE bits

SCSI Power condition mode page fields with which the ATA POWER CONDITION CHANGEABLE bit is associated	Associated ATA power conditions descriptor and log page in the ATA Power Conditions log	
	Power conditions descriptor	Log page
IDLE_A bit and IDLE_A CONDITION TIMER field	Idle_a	Idle
IDLE_B bit and IDLE_B CONDITION TIMER field	Idle_b	
IDLE_C bit and IDLE_C CONDITION TIMER field	Idle_c	
STANDBY_Y bit and STANDBY_Y CONDITION TIMER field	Standby_y	Standby
STANDBY_Z bit and STANDBY_Z CONDITION TIMER field	Standby_z	

10.1.11.2.2.4 MODE SELECT processing to modify the ATA Power Conditions log

To modify the contents of the ATA Power Conditions log for a specific pair of fields from the Power condition mode page, the SATL shall send an ATA SET FEATURES – Set Power Condition Timer EPC subcommand with:

a) the ATA POWER CONDITION ID field set as shown in table 106;
b) the ATA SAVE bit set to the value of the SP bit in MODE SELECT command CDB;
c) the ATA ENABLE bit set according to the value in the field shown in table 106; and
d) the ATA TIMER UNITS bit and ATA TIMER field set to the translated values for the field shown in table 107 as defined in 10.1.11.2.2.5.

If the ATA SET FEATURES command terminates with an error, then the SATL shall terminate the MODE SELECT command as described in 10.1.11.2.4.3.

The SATL translations based on bits in the Power condition mode page are show in table 106.

Table 106 — Power condition mode page bit translations to the ATA SET FEATURES command

SCSI Power condition mode page bits that the SATL may translate for a MODE SELECT command	Values to be set in the ATA SET FEATURES command bits and fields	
	POWER CONDITION ID field	ENABLE bit
IDLE_A bit	81h	contents of the IDLE_A bit
IDLE_B bit	82h	contents of the IDLE_B bit
IDLE_C bit	83h	contents of the IDLE_C bit
STANDBY_Y bit	01h	contents of the STANDBY_Y bit
STANDBY_Z bit	00h	contents of the STANDBY_Z bit

The SATL translations based on fields in the Power condition mode page are shown in table 107.

Table 107 — Power condition mode page field translations to the ATA SET FEATURES command

SCSI Power condition mode page fields that the SATL may translate for a MODE SELECT command	ATA SET FEATURES command bits and fields	
	POWER CONDITION ID field	TIMER UNITS bit and TIMER field [b]
IDLE_A CONDITION TIMER field	81h	IDLE_A CONDITION TIMER field
IDLE_B CONDITION TIMER field	82h	IDLE_B CONDITION TIMER field
IDLE_C CONDITION TIMER field	83h	IDLE_C CONDITION TIMER field
STANDBY_Y CONDITION TIMER field	01h	STANDBY_Y CONDITION TIMER field
STANDBY_Z CONDITION TIMER field	00h	STANDBY_Z CONDITION TIMER field

[b] The SATL shall set timer unit bit and timer field to the translated values described in 10.1.11.2.2.5.

10.1.11.2.2.5 MODE SELECT command condition timer field translation for EPC

The SATL shall translate 32-bit condition timer fields (e.g., the IDLE_A CONDITION TIMER field) to 16-bit TIMER field in an ATA SET FEATURES – Set Power Condition Timer command as shown in Table 108.

Table 108 — MODE SELECT condition timer field translation for EPC

Power condition mode page condition timer field	ATA TIMER UNITS field	ATA TIMER field [a]
0	0	1
1 to 65 535 (i.e., 0.1 second to 6 553.5 seconds)	0	z
65 536 to 39 321 000 (i.e., 109.2 minutes to 1092 hours and 15 minutes)	1	INT(z/600) [b]
Greater than 39 321 000	1	FFFFh (i.e., 1092 hours and 15 minutes)
Key: z = Contents of the Power condition mode page condition timer field		

[a] The SATL shall read the minimum and maximum timer settings that are reported for each timer in the ATA Power Conditions log and, if required, round the translated value to a value that is greater than or equal to the minimum timer setting and less than or equal to the maximum timer setting. If any parameter is rounded, a parameter rounding error is reported for the MODE SELECT command.

[b] INT() is the integer result of the specified division operation with any decimal remainder discarded. If the decimal remainder is non-zero (i.e., the parameter is rounded), a parameter rounding error is reported for the MODE SELECT command.

10.1.11.2.3 Power condition mode page processing if ATA EPC is not supported

SATL processing for the Power condition mode page when ATA EPC is not supported (see 10.1.11.2.1) is defined in Table 109.

Table 109 — Power condition mode page fields without ATA EPC support (part 1 of 3)

Field	Changeable	Description or Reference
PS	n/a	Unspecified (see 3.4.2)
SPF	no	Shall be set to zero
PAGE CODE	no	Shall be set to 1Ah
PAGE LENGTH	no	Shall be set to 26h
PM_BG_ PRECEDENCE	n/a	Unspecified (see 3.4.2)

Table 109 — Power condition mode page fields without ATA EPC support (part 2 of 3)

Field	Changeable	Description or Reference
STANDBY_Y	no	While processing a MODE SENSE command, the STANDBY_Y bit shall be returned as zero. While processing a MODE SELECT command, if the STANDBY_Y bit is set to one, then the SATL shall terminate the command as described in 10.1.11.2.4.2; otherwise the bit is ignored.
IDLE_C	no	While processing a MODE SENSE command, the IDLE_C bit shall be returned as zero. While processing a MODE SELECT command, if the IDLE_C bit is set to one, then the SATL shall terminate the command as described in 10.1.11.2.4.2; otherwise the bit is ignored.
IDLE_B	no	While processing a MODE SENSE command, the IDLE_B bit shall be returned as zero. While processing a MODE SELECT command, if the IDLE_B bit is set to one, then the SATL shall terminate the command as described in 10.1.11.2.4.2; otherwise the bit is ignored.
IDLE_A	no	While processing a MODE SENSE command, the IDLE_A bit shall be returned as zero. While processing a MODE SELECT command, if the IDLE_A bit is set to one, then the SATL shall terminate the command as described in 10.1.11.2.4.2; otherwise the bit is ignored.
STANDBY_Z	yes	While processing a MODE SENSE command, the STANDBY_Z bit shall be set to the value in ATA IDENTIFY DEVICE data word 49, bit 13. While processing a MODE SELECT command, if the STANDBY_Z bit is set to one, then: 1) if the ATA IDENTIFY DEVICE data word 49, bit 13 is set to zero, then the SATL shall terminate the command as described in 10.1.11.2.4.2; and 2) if the ATA IDENTIFY DEVICE data word 49, bit 13 is set to one, then: A) the SATL shall send the ATA STANDBY command to the ATA device; and B) the value in the STANDBY_Z CONDITION TIMER field shall be translated as defined in Table 111and used to set the Standby timer period value (i.e., the ATA COUNT field) in the command.
IDLE_A CONDITION TIMER	no	While processing a MODE SENSE command, this field shall be returned as zero. While processing a MODE SELECT command, this field shall be ignored.

Table 109 — Power condition mode page fields without ATA EPC support (part 3 of 3)

Field	Changeable	Description or Reference
STANDBY_Z CONDITION TIMER	yes	While processing a MODE SENSE command: a) if the ATA IDENTIFY DEVICE data word 49, bit 13 is set to zero, then the STANDBY_Z CONDITION TIMER field shall be set to zero; or b) if the ATA IDENTIFY DEVICE data word 49, bit 13 is set to one, then the ATA standby timer value shall be translated as defined in Table 110 and returned in the STANDBY_Z CONDITION TIMER field. While processing a MODE SELECT command, if the STANDBY_Z bit is set to one, then the value in the STANDBY_Z CONDITION TIMER field shall be translated as defined in Table 111 and used to set the Standby timer period value (i.e., the ATA COUNT field). The SATL may retain this value for return while processing a subsequent MODE SENSE command.
IDLE_B CONDITION TIMER	yes	While processing a MODE SENSE command, this field shall be returned as zero. While processing a MODE SELECT command, this field shall be ignored.
IDLE_C CONDITION TIMER	yes	While processing a MODE SENSE command, this field shall be returned as zero. While processing a MODE SELECT command, this field shall be ignored.
STANDBY_Y CONDITION TIMER	yes	While processing a MODE SENSE command, this field shall be returned as zero. While processing a MODE SELECT command, this field shall be ignored.
CCF IDLE	n/a	Unspecified (see 3.4.2)
CCF STANDBY	n/a	Unspecified (see 3.4.2)
CCF STOPPED	n/a	Unspecified (see 3.4.2)

Values in the STANDBY_Z TIMER field for the MODE SENSE command shall be translated as described in Table 110.

Table 110 — MODE SENSE STANDBY_Z TIMER field translation

ATA COUNT field [a]	Time	STANDBY_Z CONDITION TIMER field
01h through F0h	5 s to 1 200 s	ATA COUNT field x 50
FCh	21 min	12 600
FFh	21 min, 15 s	12 750
F1h through FBh	30 min to 330 min	(ATA COUNT field - 240) x 18 000
FDh	8 h to 12 h	432 000
Not retained by the SATL	n/a	FFFF_FFFFh

[a] All other values are unspecified (see 3.4.2).

Values in the STANDBY_Z TIMER field for the MODE SELECT command shall be translated as defined in Table 111.

Table 111 — MODE SELECT STANDBY_Z TIMER field translation

STANDBY_ZV CONDITION TIMER field	Time	ATA COUNT field
0	0 s	The SATL shall send an ATA STANDBY IMMEDIATE command to the ATA device
1 to 12 000	0.001 s to 12 s	INT((z - 1) / 50) + 1[a]
12 001 to 12 600	12.001 s to 12.6 s	FCh
12 601 to 12 750	12.601 s to 12.75 s	FFh
12 751 to 17 999	12.751 s to 17.999 s	F1h
18 000 to 198 000	18 s to 55 h	INT(z / 18 000) + 240[a]
All other values		FDh

Key:
z = Contents of the Power condition mode page STANDBY CONDITION TIMER field.

[a] INT() is the integer result of the specified division operation with any decimal remainder discarded.

10.1.11.2.4 Command completion for the Power condition mode page

10.1.11.2.4.1 Summary command completion for the Power condition mode page

If the MODE SENSE command for the Power condition mode page has not been terminated during processing as described in 10.1.11.2.2, 10.1.11.2.3, or 10.1.11.2.4.3, then the command shall be completed with GOOD status.

The priority of reporting completion status for MODE SELECT commands for the Power condition mode page shall be:

1) CHECK CONDITION status caused by command translation error (e.g., a parameter value that is not correctable using parameter rounding) (see 10.1.11.2.4.2);
2) CHECK CONDITION status caused by an error returned by the ATA device (see 10.1.11.2.4.3);or
3) GOOD status.

10.1.11.2.4.2 Command translation errors

If the SATL encounters an error during the translation of a MODE SENSE command or a MODE SELECT command for the Power condition mode page, then SATL shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to:

a) INVALID FIELD IN CDB, if the field that caused the error is in the CDB; or
b) INVALID FIELD IN PARAMETER LIST, if the field that caused the error is in the mode parameter list (see SPC-4).

10.1.11.2.4.3 Errors returned by the ATA device

If the ATA device terminates ATA command with a error during the translation of a MODE SENSE command or a MODE SELECT command for the Power condition mode page, then SATL shall terminate the MODE SENSE command or a MODE SELECT command with CHECK CONDITION status, with the sense key set to ABORTED COMMAND and additional sense code set to COMMAND SEQUENCE ERROR

10.2 Log parameters

10.2.1 Log parameters overview

This standard defines translations for the log pages listed in table 112.

Table 112 — Summary of SCSI / ATA log page mapping (part 1 of 2)

SCSI log page	Reference
Application Client (i.e., page code 0Fh/00h)	10.2.2
Supported Log Pages (i.e., page code 00h/00h)	10.2.3
Supported Log Pages and Subpages (i.e., page code 00h/FFh)	10.2.4
Self-Test Results (i.e., page code 10h/00h)	10.2.5
Informational Exceptions (i.e., page code 2Fh/00h)	10.2.6
Read Error Counters (i.e., page code 03h/00h)	10.2.7
Temperature (i.e., page code (0Dh/00h)	10.2.8

Table 112 — Summary of SCSI / ATA log page mapping (part 2 of 2)

SCSI log page	Reference
Solid State Media (i.e., page code 11h/00h)	10.2.9
Background Scan (i.e., page code 15h/00h)	10.2.10
General Statistics and Performance (i.e., page code 19h/00h)	10.2.11
All others	Unspecified (see 3.4.2)

10.2.2 Application Client log page

10.2.2.1 Translation Overview

The Application Client log page provides a location for application clients to store information. A SATL translates a LOG SELECT command or LOG SENSE command to the Application Client log page to accesses to the ATA host vendor-specific log pages. Table 113 describes the translation of the general usage application client parameter data for the Application Client log page.

The SATL determines if the ATA device supports host vendor specific log pages by reading ATA log page address 00h using an ATA read log command.

If the ATA device:

c) does not support the general purpose logging feature set and the SMART feature set is disabled; or
d) does not support host vendor-specific log pages,

then the SATL shall complete the LOG SENSE command or LOG SELECT command for the Application Client log page with a CHECK CONDITION status, a sense key of ILLEGAL REQUEST, and an additional sense code of INVALID FIELD IN CDB.

Table 113 — General usage Application Client log parameter fields

Field	Description or reference
PARAMETER CODE	10.2.2.2
DU	Shall be set to one
TSD	Shall be set to zero
ETC	Shall be set to zero
TMC	This field is ignored
FORMAT AND LINKING	Shall be set to 11b
PARAMETER LENGTH	Shall be set to FCh
GENERAL USAGE PARAMETER BYTES	10.2.2.2

10.2.2.2 LOG SELECT translation

The SATL stores the application client parameter for a LOG SELECT command in the ATA device host vendor-specific log page. The SATL stores the application client parameter data at the ATA log address as specified in table 114.

Within an ATA log address, the SATL shall store each parameter code in ascending order within the sixteen 512-byte data blocks for each ATA log address (e.g., parameter code 0000h is stored at offset 0 of the first 512-byte block of data at log address 90h and parameter code 0001h is stored at offset 256 in the first 512-byte block of data at log address 90h). The SATL stores this information by issuing an ATA write log command.

The SATL shall ensure that any previously stored data at the log address is preserved when writing to the log address for the requested parameter data.

Table 114 — Parameter storage location

Parameter code	ATA log address
0000h through 001Fh	90h
0020h through 003Fh	91h
0040h through 005Fh	92h
0060h through 007Fh	93h
0080h through 009Fh	94h
00A0h through 00BFh	95h
00C0h through 00DFh	96h
00E0h through 00FFh	97h
0100h through 011Fh	98h
0120h through 013Fh	99h
0140h through 015Fh	9Ah
0160h through 017Fh	9Bh
0180h through 019Fh	9Ch
01A0h through 01BFh	9Dh
01C0h through 01DFh	9Eh
01E0h through 01FFh	9Fh
All other values	Reserved

10.2.2.3 LOG SENSE translation

The SATL retrieves the requested parameter data by reading the ATA log address (see table 114) that stores the parameter code using an ATA read log command.

10.2.3 Supported Log Pages log page

The Supported Log Pages log page (see table 115) returns the list of log pages supported by the SATL (see SPC-4).

Table 115 — Supported Log Pages log page fields

Field	Description or reference
DS	Unspecified (see 3.4.2)
SPF	Shall be set to zero
PAGE CODE	Shall be set to zero
SUBPAGE CODE	Shall be set to zero
PAGE LENGTH	Unspecified (see 3.4.2)
Supported pages	The SATL shall include log pages as follows: a) the Informational Exceptions log page if the ATA device supports the ATA SMART feature set (i.e., ATA IDENTIFY DEVICE data log SMART bit is set to one); and b) the Self-Test Results log page if the ATA device supports the ATA SMART self-test (i.e., ATA IDENTIFY DEVICE data log SMART SELF-TEST SUPPORTED bit is set to one). The SATL may include other pages.

10.2.4 Supported Log Pages and Subpages log page

The Supported Log Pages and Subpages log page returns the list of log pages and subpages supported by the SATL (see SPC-4).

Table 116 — Supported Log Pages and Subpages log page fields

Field	Description or reference
DS	Unspecified (see 3.4.2)
SPF	Shall be set to one
PAGE CODE	Shall be set to zero
SUBPAGE CODE	Shall be set to FFh
PAGE LENGTH	Unspecified (see 3.4.2)
Supported pages and subpages	As defined for Supported Log Pages log page translation (see 10.2.3)

10.2.5 Self-Test Results log page

10.2.5.1 Self-Test Results log page overview

The Self-Test Results log page provides the results from self-test results descriptor entry pointed to by the Self-test descriptor index. Table 117 shows the Self-Test Results log page header fields.

Table 117 — Self-Test Results log page fields

Field	Description or reference
DS	Unspecified (see 3.4.2)
SPF	Shall be set to zero
PAGE CODE	Shall be set to 10h
SUBPAGE CODE	Shall be set to zero
PAGE LENGTH	Shall be set to 0190h

Translations of the fields for the Self-Test Results log parameters for the Self-Test Results log page are shown in table 118..

Table 118 — Self-Test Results log parameters (part 1 of 4)

Field	Description or reference
PARAMETER CODE	The SATL shall return log parameters with the PARAMETER CODE field set to 0001h through 0014h.
DU	Shall be set to zero
TSD	Shall be set to zero
ETC	Shall be set to zero
TMC	Shall be set to zero
FORMAT AND LINKING	Shall be set to 11b
PARAMETER LENGTH	Shall be set to 10h

Table 118 — Self-Test Results log parameters (part 2 of 4)

Field	Description or reference
SELF-TEST CODE	The SATL shall read the ATA log data as defined in 10.2.5.2. If the SATL reads the ATA log data using the ATA READ LOG EXT command or the ATA READ LOG DMA EXT command specifying the Extended SMART self-test log, then the SATL shall check if the value contained in the Self-test descriptor index field in the first log page (i.e., bytes 2 and 3) is set to zero. If the value contained in the Self-test descriptor index field is set to zero, then the SATL shall set the SELF-TEST CODE field to zero for each of the log parameters returned. If the value contained in the Self-test descriptor index field is set to a non-zero value, then the SELF-TEST CODE field is unspecified (see 3.4.2). If the SATL reads the ATA log data using the ATA SMART READ LOG command specifying the SMART self-test log, then the SELF-TEST CODE field is unspecified (see 3.4.2).
SELF-TEST RESULTS	The SATL shall read the ATA log data as defined in 10.2.5.2. If the SATL reads the ATA log data using the ATA READ LOG EXT command or the ATA READ LOG DMA EXT command specifying the Extended SMART self-test log, then the SATL shall check if the value contained in the Self-test descriptor index field in the first block of data (i.e., bytes 2 and 3) is set to zero. If the value contained in the Self-test descriptor index field is set to zero, then the SATL shall set the SELF-TEST RESULTS field to zero for each log parameter returned. If the value contained in the Self-test descriptor index field is set to a nonzero value, then the SATL shall set the SELF-TEST RESULTS field to: a) the value contained in the Self-test Execution Status bits of the content of the self-test execution status byte field of the n^{th} descriptor entry, where n is equal to the result of the value contained in the Self-test descriptor index field minus the value contained in the PARAMETER CODE field for the log parameter being returned plus one, if the result of the value contained in the Self-test descriptor index field minus the value contained in the PARAMETER CODE field for the log parameter being returned plus one is greater than zero (e.g., for a log parameter with the PARAMETER CODE field of 0002h and a value contained in the Selftest descriptor index field of 6h, then the fifth descriptor entry is used); or b) zero, if the result of the value contained in the Self-test descriptor index field minus the value contained in the PARAMETER CODE field for the log parameter being returned plus one is less than or equal to zero. If the SATL reads the ATA log data using the ATA SMART READ LOG command specifying the SMART self-test log, then the SATL shall set the SELF-TEST RESULTS field to the value contained in the Self-test Execution Status bits of the content of the self-test execution status byte field of the nth descriptor entry, where n is equal to the value contained in the PARAMETER CODE field for the log parameter being returned (e.g., for a log parameter with the PARAMETER CODE field of 0002h, then the second descriptor entry is used).
SELF-TEST NUMBER	Unspecified (see 3.4.2)

Table 118 — Self-Test Results log parameters (part 3 of 4)

Field	Description or reference
ACCUMULATED POWER ON HOURS	The SATL shall read the ATA log data as defined in 10.2.5.2. If the SATL reads the ATA log data using the ATA READ LOG EXT command or the ATA READ LOG DMA EXT command specifying the Extended SMART self-test log, then the SATL shall check if the value contained in the Self-test descriptor index field in the first block of data (i.e., bytes 2 and 3) is set to zero. If the value contained in the Self-test descriptor index field is set to zero, then the SATL shall set the TIMESTAMP field to zero for each log parameter returned. If the value contained in the Self-test descriptor index field is set to a nonzero value, then the SATL shall set the TIMESTAMP field to: a) the values contained in the ATA LIFE TIMESTAMP field of the n^{th} descriptor entry, where n is equal to the result of the value contained in the Self-test descriptor index field minus the value contained in the PARAMETER CODE field for the log parameter being returned plus one, if the result of value contained in the Self-test descriptor index field minus the value contained in the PARAMETER CODE field for the log parameter being returned plus one is greater than zero (e.g., for a log parameter with the PARAMETER CODE field of 0002h and a value contained in the Selftest descriptor index field of 6h, then the fourth descriptor entry is used); or b) zero, if the result of the value contained in the Self-test descriptor index field minus the value contained in the PARAMETER CODE field for the log parameter being returned plus one is less than or equal to zero. If the SATL reads the ATA log data using the ATA SMART READ LOG command specifying the SMART self-test log, then the SATL shall set the TIMESTAMP field to the values contained in the ATA LIFE TIMESTAMP field of the n^{th} descriptor entry, where n is equal to the value contained in the PARAMETER CODE field for the log parameter being returned (e.g., for a log parameter with the PARAMETER CODE field of 0002h, then the second descriptor entry is used).

Table 118 — Self-Test Results log parameters (part 4 of 4)

Field	Description or reference
ADDRESS OF FIRST FAILURE	The SATL shall read the ATA log data as defined in 10.2.5.2. If the SATL reads the ATA log data using the ATA READ LOG EXT command or the ATA READ LOG DMA EXT command specifying the Extended SMART self-test log, then the SATL shall check if the value contained in the Self-test descriptor index field in the first block of data (i.e., bytes 2 and 3) is set to zero. If the value contained in the Self-test descriptor index field is set to zero, then the SATL shall set the ADDRESS OF FIRST FAILURE field to zero for each log parameter returned. If the value contained in the Self-test descriptor index field is set to a nonzero value, then the SATL shall set the ADDRESS OF FIRST FAILURE field to: a) the values contained in the Failing LBA (47:40) field, Failing LBA (39:32) field, Failing LBA (31:24) field, Failing LBA (23:16) field, Failing LBA (15:8) field, and Failing LBA (7:0) field of the n^{th} descriptor entry, where n is equal to the result of the value contained in the Self-test descriptor index field minus the value contained in the PARAMETER CODE field for the log parameter being returned plus one, if the result of the value contained in the Self-test descriptor index field minus the value contained in the PARAMETER CODE field for the log parameter being returned plus one is greater than zero (e.g., for a log parameter with the PARAMETER CODE field of 0002h and a value contained in the Self-test descriptor index field of 6h, then the fourth descriptor entry is used); or b) zero, if the result of the value contained in the Self-test descriptor index field minus the value contained in the PARAMETER CODE field for the log parameter being returned plus one is less than or equal to zero. If the SATL reads the ATA log data using the ATA SMART READ LOG command specifying the SMART self-test log, then the SATL shall set the ADDRESS OF FIRST FAILURE field to the values contained in the Failing LBA (27:24) field, Failing LBA (23:16) field, Failing LBA (15:8) field, and Failing LBA (7:0) field of the n^{th} descriptor entry, where n is equal to the value contained in the PARAMETER CODE field for the log parameter being returned (e.g., for a log parameter with the PARAMETER CODE field of 0002h, then the second descriptor entry is used).
SENSE KEY	10.2.5.3
ADDITIONAL SENSE CODE	10.2.5.3
ADDITIONAL SENSE CODE QUALIFIER	10.2.5.3

10.2.5.2 A method of determining ATA command selection for field translations

To translate the SELF-TEST CODE field, the SELF-TEST RESULTS field, the TIMESTAMP field, the ADDRESS OF FIRST FAILURE field, the SENSE KEY field, the ADDITIONAL SENSE CODE field, and the ADDITIONAL SENSE CODE QUALIFIER field of Self-Test Results log parameters, the SATL shall send an ATA IDENTIFY DEVICE command to the ATA device, and from the returned data the SATL shall determine if the ATA device supports the 48-bit Address feature set. If the 48-bit Address feature set is supported (i.e., ATA IDENTIFY DEVICE data log 48-BIT

SUPPORTED bit is set to one), then the SATL shall send an ATA READ LOG EXT command with the Log address set to 07h (i.e., Extended SMART self-test log) to the ATA device. If the 48-bit Address feature set is not supported (i.e., ATA IDENTIFY DEVICE data log 48-BIT SUPPORTED bit is set to zero), then the SATL shall send an ATA SMART READ LOG command with the Log address set to 06h (i.e., SMART self-test log) to the ATA device.

10.2.5.3 Sense key and additional sense code

The SATL shall determine the SENSE KEY field, the ADDITIONAL SENSE CODE field, and the ADDITIONAL SENSE CODE QUALIFIER field returned in each log parameter from the content of the self-test execution status byte returned from a ATA read log command sent to the ATA device (see 10.2.5.2). The values returned in each log parameter shall be translated into sense data for the sense key, and additional sense code as shown in table 119.

Table 119 — ATA Self-test execution status values translated to SCSI sense keys and sense codes

ATA	SCSI		
Self-Test execution status value	**Sense key**	**Additional sense code**	**NN**
0	NO SENSE	NO ADDITIONAL SENSE INFORMATION	n/a
1	ABORTED COMMAND	DIAGNOSTIC FAILURE ON COMPONENT NN (80h - FFh)	81h
2		DIAGNOSTIC FAILURE ON COMPONENT NN (80h - FFh)	82h
3		DIAGNOSTIC FAILURE ON COMPONENT NN (80h - FFh)	83h
4	HARDWARE ERROR	DIAGNOSTIC FAILURE ON COMPONENT NN (80h - FFh)	84h
5		DIAGNOSTIC FAILURE ON COMPONENT NN (80h - FFh)	85h
6		DIAGNOSTIC FAILURE ON COMPONENT NN (80h - FFh)	86h
7	MEDIUM ERROR	DIAGNOSTIC FAILURE ON COMPONENT NN (80h - FFh)	87h
8	HARDWARE ERROR	DIAGNOSTIC FAILURE ON COMPONENT NN (80h - FFh)	88h
9-14	Unspecified (see 3.4.2) [a]		
15	NO SENSE	NO ADDITIONAL SENSE INFORMATION	n/a

[a] Self-Test execution status values from 9 to 14 are reserved in ACS-3.

10.2.6 Informational Exceptions log page

10.2.6.1 Informational Exceptions log page overview

The Informational Exceptions log page provides detail about informational exceptions. The SATL shall send the ATA SMART RETURN STATUS command to the ATA device. Data returned from the ATA device shall be translated into the appropriate log sense parameter data (see 10.2.6.2) to be returned to the application client.Table 120 shows the log page header fields.

Table 120 — Informational Exceptions log page header fields

Field	Description or reference
DS	Unspecified (see 3.4.2)
SPF	Shall be set to zero
PAGE CODE	Shall be set to 2Fh.
SUBPAGE CODE	Shall be set to zero
PAGE LENGTH	Unspecified (see 3.4.2)

The first log parameter is the informational exceptions general parameter shown in table 121.

Table 121 — Informational Exceptions general parameter data

Field	Description or reference
PARAMETER CODE	Shall be set to 0000h
DU	Shall be set to zero
TSD	Shall be set to zero
ETC	Shall be set to zero
TMC	Shall be set to zero
FORMAT AND LINKING	Shall be set to 11b
PARAMETER LENGTH	Unspecified (see 3.4.2)
INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE	10.2.6.2
INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE QUALIFIER	10.2.6.2
MOST RECENT TEMPERATURE READING	10.2.6.3
Vendor specific	Unspecified (see 3.4.2)

10.2.6.2 Additional sense code and additional sense code qualifier translations

Data received from a ATA device in response to an ATA SMART RETURN STATUS command shall be translated by the SATL into the informational exceptions general parameter data returned to the application client. Table 122 provides the parameter data translations for the INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE field and the INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE QUALIFIER field.

Table 122 — ATA SMART RETURN STATUS translations

Data returned to SATL from the ATA device by the ATA SMART RETURN STATUS command	SMART condition	Informational exceptions general parameter data fields
LBA Mid = 4Fh LBA High = C2h	threshold not exceeded	INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE = 00h, INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE QUALIFIER = 00h
LBA Mid = F4h LBA High = 2Ch	threshold exceeded	INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE = 5Dh, INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE QUALIFIER = 10h

10.2.6.3 Most recent temperature reading translation

If the ATA device supports the SCT Feature Set (see ACS-3), then to translate the MOST RECENT TEMPERATURE READING field of the Informational Exceptions log page, the SATL shall send an ATA SCT Status Request to the ATA device; and then:

a) if the HDA Temp field in the SCT Command/Status log (see ACS-3) is less than zero, the SATL shall set the MOST RECENT TEMPERATURE READING field to zero;
b) if the HDA Temp field is equal to 80h, the SATL shall set the MOST RECENT TEMPERATURE READING field to FFh; or
c) the SATL shall set the MOST RECENT TEMPERATURE READING field to the value in the HDA Temp field.

If the ATA device does not support the SCT feature set, then the SATL shall set the MOST RECENT TEMPERATURE READING field to FFh.

10.2.7 Read Error Counters log page

10.2.7.1 Read Error Counters log page overview

The Read Error Counters log page provides detail about read errors. Table 123 shows the parameters that may be returned. .

Table 123 — Read Error Counters log page parameters

Parameter	Reference
Total Times Correction Algorithm Processed	10.2.7.2
Total Uncorrected Errors	10.2.7.3

Table 124 shows the log page header fields

Table 124 — Read Error Counters log page header fields

Field	Description or reference
DS	Unspecified (see 3.4.2)
SPF	Shall be set to zero
PAGE CODE	Shall be set to 03h
SUBPAGE CODE	Shall be set to zero
PAGE LENGTH	Unspecified (see 3.4.2)

10.2.7.2 Total Times Correction Algorithm Processed log parameter

The Total Times Correction Algorithm Processed log parameter is unspecified (see 3.4.2) unless:

a) the ATA Read Recovery Attempts statistic is supported (i.e., bit 63 of the ATA QWord located at byte 40 of the Rotating Media Statistics page of the ATA Device Statistics log is set to one); and
b) the ATA Read Recovery Attempts statistic is valid (i.e., bit 62 of the ATA QWord located at byte 40 of the Rotating Media Statistics page of the ATA Device Statistics log is set to one).

If the ATA Read Recovery Attempts statistic is supported and valid, then the SATL shall return the Total Times Correction Algorithm Processed log parameter as shown in table 125.

Table 125 — Total Times Correction Algorithm Processed log parameter fields

Field	Description or reference
PARAMETER CODE	Shall be set to 0004h
DU	Shall be set to zero
TSD	Shall be set to zero
ETC	Unspecified (see 3.4.2)
TMC	Unspecified (see 3.4.2)
FORMAT AND LINKING	Shall be set to 10b
PARAMETER LENGTH	Shall be set to 04h
TOTAL TIMES CORRECTION ALGORITHM PROCESSED	Shall be set to bits 31:0 of the ATA Read Recovery Attempts statistic.

10.2.7.3 Total Uncorrected Errors log parameter

The Total Uncorrected Errors log parameter is unspecified (see 3.4.2) unless:

a) the ATA Number of Reported Uncorrectable Errors statistic is supported (i.e., bit 63 of the ATA QWord located at byte 8 of the General Errors Statistics page of the ATA Device Statistics log is set to one); and
b) the ATA Number of Reported Uncorrectable Errors statistic is valid (i.e., bit 62 of the ATA QWord located at byte 8 of the General Errors Statistics page of the ATA Device Statistics log is set to one).

If the ATA Number of Reported Uncorrectable Errors statistic is supported and valid, then the SATL shall return the Total Uncorrected Errors log parameter as shown in table 126.

Table 126 — Total Uncorrected Errors log parameter fields

Field	Description or reference
PARAMETER CODE	Shall be set to 0006h
DU	Shall be set to zero
TSD	Shall be set to zero
ETC	Unspecified (see 3.4.2).
TMC	Unspecified (see 3.4.2)
FORMAT AND LINKING	Shall be set to 10b
PARAMETER LENGTH	Shall be set to 04h
TOTAL UNCORRECTED ERRORS	Shall be set to bits 31:0 of the ATA Number of Reported Uncorrectable Errors statistic

10.2.8 Temperature log page

10.2.8.1 Temperature log page overview

The Temperature log page provides detail about the temperature reported by the device server. Table 127 shows the parameters that may be returned.

Table 127 — Temperature Log Page Parameters

Parameter	Reference
Temperature	10.2.8.2
Reference Temperature	10.2.8.3

Table 128 shows the log page header fields.

Table 128 — Temperature log page header fields

Field	Description or reference
DS	Unspecified (see 3.4.2)
SPF	Shall be set to zero
PAGE CODE	Shall be set to 0Dh
SUBPAGE CODE	Shall be set to zero
PAGE LENGTH	Unspecified (see 3.4.2)

10.2.8.2 Current Temperature log parameter

The Current Temperature log parameter is unspecified (see 3.4.2) unless:

a) the ATA Current Temperature statistic is supported (i.e., bit 63 of the ATA QWord located at byte 8 of the Temperature Statistics page of the ATA Device Statistics log is set to one); and
b) the ATA Current Temperature statistic is valid (i.e., bit 62 of the ATA QWord located at byte 8 of the Temperature Statistics page of the ATA Device Statistics log is set to one).

If the ATA Current Temperature statistic is supported and valid, then the SATL shall return the Temperature log parameter as shown in table 129.

Table 129 — Temperature log parameter fields

Field	Description or reference
PARAMETER CODE	Shall be set to 0000h
DU	Shall be set to zero
TSD	Shall be set to zero
ETC	Unspecified (see 3.4.2)
TMC	Unspecified (see 3.4.2)
FORMAT AND LINKING	Shall be set to 11b
PARAMETER LENGTH	Shall be set to 02h
TEMPERATURE	a) if bit 7 of the ATA Current Temperature statistic is set to one, then the SATL shall set bits 7:0 of the TEMPERATURE field to 00h; and b) if bit 7 of the ATA Current Temperature statistic is set to zero, then the SATL shall set bits 7:0 of the TEMPERATURE field to bits 7:0 of the ATA Current Temperature statistic.

10.2.8.3 Reference Temperature log parameter

The Reference Temperature log parameter is unspecified (see 3.4.2) unless:

c) the ATA Specified Maximum Operating Temperature statistic is supported (i.e., bit 63 of the ATA QWord located at byte 88 of the Temperature Statistics page of the ATA Device Statistics log is set to one); and
d) the ATA Specified Maximum Operating Temperature statistic is valid (i.e., bit 62 of the ATA QWord located at byte 88 of the Temperature Statistics page of the ATA Device Statistics log is set to one).

If the ATA Specified Maximum Operating Temperature statistic is supported and valid, then the SATL shall return the Reference Temperature log parameter as shown in table 130.

Table 130 — Reference Temperature log parameter fields

Field	Description or reference
PARAMETER CODE	Shall be set to 0001h
DU	Shall be set to zero
TSD	Shall be set to zero
ETC	Unspecified (see 3.4.2)
TMC	Unspecified (see 3.4.2)
FORMAT AND LINKING	Shall be set to 11b
PARAMETER LENGTH	Shall be set to 02h
REFERENCE TEMPERATURE	a) if bit 7 of the ATA Specified Maximum Operating Temperature statistic is set to one, then the SATL shall set bits 7:0 of the REFERENCE TEMPERATURE field to 00h; and b) if bit 7 of the ATA Specified Maximum Operating Temperature statistic is set to zero, then the SATL shall set bits 7:0 of the REFERENCE TEMPERATURE field to the ATA Specified Maximum Operating Temperature statistic.

10.2.9 Solid State Media log page

10.2.9.1 Solid State Media log page overview

The Solid State Media log page provides detail about solid state media. Table 131 shows the parameters that may be returned.

Table 131 — Solid State Media log page parameters

Parameter	Reference
Percentage Used Endurance Indicator	10.2.9.2

Table 132 shows the log page header fields.

Table 132 — Solid State Media log page header fields

Field	Description or reference
DS	Unspecified (see 3.4.2)
SPF	Shall be set to zero
PAGE CODE	Shall be set to 11h
SUBPAGE CODE	Shall be set to zero
PAGE LENGTH	Unspecified (see 3.4.2)

10.2.9.2 Percentage Used Endurance Indicator log parameter

The Percentage Used Endurance Indicator log parameter is unspecified (see 3.4.2) unless:

a) the ATA Percentage Used Endurance Indicator statistic is supported (i.e., bit 63 of the ATA QWord located at byte 8 of the Solid State Device Statistics page of the ATA Device Statistics log is set to one); and
b) the ATA Percentage Used Endurance Indicator statistic is valid (i.e., bit 62 of the ATA QWord located at byte 8 of the Solid State Device Statistics page of the ATA Device Statistics log is set to one).

If the ATA Percentage Used Endurance Indicator statistic is supported and valid, then the SATL shall return the Percentage Used Endurance Indicator log parameter as shown in table 133.

Table 133 — Percentage Used Endurance Indicator log parameter fields

Field	Description or reference
PARAMETER CODE	Shall be set to 0001h
DU	Shall be set to zero
TSD	Shall be set to zero
ETC	Unspecified (see 3.4.2)
TMC	Unspecified (see 3.4.2)
FORMAT AND LINKING	Shall be set to 11b
PARAMETER LENGTH	Shall be set to 04h
PERCENTAGE USED ENDURANCE INDICATOR	Shall be set to the value of the ATA Percentage Used Endurance Indicator statistic.

10.2.10 Background Scan Results log page

10.2.10.1 Background Scan Results log page overview

The Background Scan Results log page provides detail about background scan status. Table 134 shows the parameters that may be returned.

Table 134 — Background Scan Status log page parameters

Parameter	Reference
Background Scan Status	10.2.10.2

Table 135 shows the log page header fields.

Table 135 — Background Scan Results log page header fields

Field	Description or reference
DS	Unspecified (see 3.4.2)
SPF	Shall be set to zero
PAGE CODE	Shall be set to 15h
SUBPAGE CODE	Shall be set to zero
PAGE LENGTH	Unspecified (see 3.4.2)

10.2.10.2 Background Scan Status log parameter

The Background Scan Status log parameter is unspecified (see 3.4.2) unless:

a) the ATA Power-on Hours statistic is supported (i.e., bit 63 of the ATA QWord located at byte 16 of the General Statistics page of the ATA Device Statistics log is set to one); and
b) the ATA Power-on Hours statistic is valid (i.e., bit 62 of the ATA QWord located at byte 16 of the General Statistics page of the ATA Device Statistics log is set to one).

If the ATA Power-on Hours statistic is supported and valid, then the SATL shall return the Background Scan Status log parameter as shown in table 136.

Table 136 — Background Scan Status log parameter fields

Field	Description or reference
PARAMETER CODE	Shall be set to 0000h
DU	Shall be set to zero
TSD	Shall be set to zero
ETC	Unspecified (see 3.4.2)
TMC	Unspecified (see 3.4.2)
FORMAT AND LINKING	Shall be set to 11b
PARAMETER LENGTH	Shall be set to 0Ch
ACCUMULATED POWER ON MINUTES	Shall be set to 60 times the value of the ATA Power-on Hours statistic.

Table 136 — Background Scan Status log parameter fields

Field	Description or reference
BACKGROUND SCAN STATUS	Unspecified (see 3.4.2)
NUMBER OF BACKGROUND SCANS PERFORMED	Unspecified (see 3.4.2)
BACKGROUND SCAN PROGRESS	Unspecified (see 3.4.2)
NUMBER OF BACKGROUND MEDIUM SCANS PERFORMED	Unspecified (see 3.4.2)

10.2.11 General Statistics and Performance log page

10.2.11.1 General Statistics and Performance log page overview

The General Statistics and Performance log page provides detail about usage and performance. Table 137 shows the parameters that may be returned.

Table 137 — General Statistics and Performance log page parameters

Parameter	Reference
General Statistics and Performance	10.2.11.2

Table 138 shows the log page header fields.

Table 138 — General Statistics and Performance log page header fields

Field	Description or reference
DS	Unspecified (see 3.4.2)
SPF	Shall be set to zero
PAGE CODE	Shall be set to 19h
SUBPAGE CODE	Shall be set to zero
PAGE LENGTH	Unspecified (see 3.4.2)

10.2.11.2 General Statistics and Performance log parameters

The SATL shall:

1) send an ATA read log command to read the General Statistics page (i.e., 01h) of the Device Statistics log (i.e., 04h); and

2) return the parameter data shown in Table 139.

Table 139 — General Statistics and Performance log parameter fields

Field	Description or reference
PARAMETER CODE	Shall be set to 0001h
DU	Shall be set to zero
TSD	Shall be set to zero
ETC	Unspecified (see 3.4.2)
TMC	Unspecified (see 3.4.2)
FORMAT AND LINKING	Shall be set to 11b
PARAMETER LENGTH	Shall be set to 40h
NUMBER OF READ COMMANDS	If the ATA Number of Read Commands statistic (i.e., the ATA QWord located at byte 48 of the General Statistics page of the ATA Device Statistics log) is supported [a] and valid [b], then the SATL shall set the NUMBER OF READ COMMANDS parameter to the ATA Number of Read Commands statistic.
NUMBER OF WRITE COMMANDS	If the ATA Number of Write Commands statistic (i.e., the ATA QWord located at byte 32 of the General Statistics page of the ATA Device Statistics log) is supported [a] and valid [b], then the SATL shall set the NUMBER OF WRITE COMMANDS parameter tothe ATA Number of Write Commands statistic.
NUMBER OF LOGICAL BLOCKS RECEIVED	If the ATA Logical Sectors Written statistic (i.e., the ATA QWord located at byte 24 of the General Statistics page of the ATA Device Statistics log) is supported [a] and valid [b], then the SATL shall set the NUMBER OF LOGICAL BLOCKS RECEIVED parameter to the ATA Logical Sectors Written statistic.
NUMBER OF LOGICAL BLOCKS TRANSMITTED	If the ATA Logical Sectors Read statistic (i.e., the ATA QWord located at byte 40 of the General Statistics page of the ATA Device Statistics log) is supported [a] and valid [b], then the SATL shall set the NUMBER OF LOGICAL BLOCKS TRANSMITTED parameter to the ATA Logical Sectors Read statistic.
READ COMMAND PROCESSING INTERVALS	Unspecified (see 3.4.2)

Table 139 — General Statistics and Performance log parameter fields

Field	Description or reference
WRITE COMMAND PROCESSING INTERVALS	Unspecified (see 3.4.2)
WEIGHTED NUMBER OF READ COMMANDS PLUS NUMBER OF WRITE COMMANDS	Unspecified (see 3.4.2)
WEIGHTED READ COMMAND PROCESSING PLUS WRITE COMMAND PROCESSING	Unspecified (see 3.4.2)
[a] The parameter is supported if bit 63 of the ATA QWord is set to one. [b] The parameter is valid if bit 62 of the ATA QWord is set to one.	

10.3 Vital product data parameters

10.3.1 Vital product data parameters overview

Table 140 provides a summary of the VPD page translations defined in this standard.

Table 140 — Summary of SCSI / ATA VPD page mapping (part 1 of 2)

SCSI VPD page	Reference
Supported VPD Pages VPD page (i.e., 00h)	10.3.2
Unit Serial Number VPD page (i.e., 80h)	10.3.3
Device Identification VPD page (i.e., 83h)	10.3.4
Extended INQUIRY Data VPD page (i.e., 86h)	10.3.5
Mode Page Policy VPD page (i.e., 87h)	~~10.3.5~~10.3.6
ATA Information VPD page (i.e., 89h)	12.4.2
Power Condition VPD page (i.e., 8Ah)	~~10.3.7~~10.3.7
Block Limits VPD page (i.e., B0h)	~~10.3.9~~10.3.9

Table 140 — Summary of SCSI / ATA VPD page mapping (part 2 of 2)

SCSI VPD page	Reference
Block Device Characteristics VPD page (i.e., B1h)	~~10.3.8~~10.3.8
~~Thin~~ Logical Block Provisioning VPD page (i.e., B2h)	~~10.3.10~~10.3.10
Zoned Block Device Characteristics VPD page (i.e., B6h)	10.3.11
All others	See SPC-4 and SBC-3 Unspecified (see 3.4.2)

10.3.2 Supported VPD Pages VPD page

Table 141 shows the fields of the Supported VPD Pages VPD page.

Table 141 — Supported VPD Pages VPD page fields

Field	Description or reference
PERIPHERAL QUALIFIER	The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2.
PERIPHERAL DEVICE TYPE	
PAGE CODE	The SATL shall set this field to 00h.
PAGE LENGTH	The SATL shall set this field to indicate the length of the supported VPD page list returned in number of bytes.
Supported VPD page list	Unspecified (see 3.4.2).

10.3.3 Unit Serial Number VPD page

Table 142 shows the fields of the Unit Serial Number VPD page.

Table 142 — Unit Serial Number VPD page fields

Field	Description or reference
PERIPHERAL QUALIFIER	The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2.
PERIPHERAL DEVICE TYPE	
PAGE CODE	The SATL shall set this field to 80h.
PAGE LENGTH	Shall be set to 14h
PRODUCT SERIAL NUMBER	The PRODUCT SERIAL NUMBER field contains a representation of the Serial number field in the ATA IDENTIFY DEVICE data words 10 to 19 last retrieved from the ATA device. Each pair of bytes in the Serial number field shall be swapped to create a valid ASCII string format in the PRODUCT SERIAL NUMBER field as described in table 143

Table 143 shows the positional swapping of ATA IDENTIFY DEVICE data fields to bytes in the PRODUCT SERIAL NUMBER field.

Table 143 — PRODUCT SERIAL NUMBER field

Byte	Contents
0	IDENTIFY DEVICE word 10 bits 15:8 (i.e., byte 1)
1	IDENTIFY DEVICE word 10 bits 7:0 (i.e., byte 0)
2	IDENTIFY DEVICE word 11 bits 15:8 (i.e., byte 3)
3	IDENTIFY DEVICE word 11 bits 7:0 (i.e., byte 2)
...	...
18	IDENTIFY DEVICE word 19 bits 15:8 (i.e., byte 19)
19	IDENTIFY DEVICE word 19 bits 7:0 (i.e., byte 18)

NOTE 8 - Although SPC-4 defines the PRODUCT SERIAL NUMBER field as right-aligned, ACS-3 does not require its SERIAL NUMBER field to be right-aligned. Therefore, the PRODUCT SERIAL NUMBER field for SAT may not be right-aligned.

10.3.4 Device Identification VPD page

10.3.4.1 Device Identification VPD page overview

The SATL shall return the Device Identification VPD page (see SPC-4) as defined in table 144.

Table 144 — Device Identification VPD page fields

Field	Description or reference
PERIPHERAL QUALIFIER	The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2.
PERIPHERAL DEVICE TYPE	
PAGE CODE	The SATL shall set this field to 83h.
PAGE LENGTH	Shall be set to the length of the remaining bytes of the VPD page.
Designation descriptor	One designation descriptor for a logical unit (i.e., a logical unit name) shall be included (see clause 10.3.4.2). In some environments, one or more additional designation descriptors may be included (see clause 10.3.4.3).

10.3.4.2 Logical unit name

10.3.4.2.1 Logical unit name overview

If ATA IDENTIFY DEVICE data word 87 bit 8 is set to one indicating that the ATA device supports the World wide name field (i.e., ATA IDENTIFY DEVICE data words 108 to 111), then the SATL shall include an designation descriptor containing a logical unit name as defined in 10.3.4.2.2.

If ATA IDENTIFY DEVICE data word 87 bit 8 is set to zero, indicating that the ATA device does not support the World wide name field (i.e., ATA IDENTIFY DEVICE data words 108 to 111), then the SATL shall include an identification descriptor containing a logical unit name as defined in 10.3.4.2.3.

10.3.4.2.2 Logical unit name derived from the world wide name

Table 145 defines the logical unit name derived from the ATA device world wide name.

Table 145 — Logical unit name derived from the world wide name

Field	Description or reference
PROTOCOL IDENTIFIER	Shall be set to zero
CODE SET	Shall be set to 1h
PIV	Shall be set to zero
ASSOCIATION	Shall be set to zero
DESIGNATOR TYPE	Shall be set to 3h

Table 145 — Logical unit name derived from the world wide name

Field	Description or reference
DESIGNATOR LENGTH	Shall be set to 08h
NAA	See table 146
IEEE COMPANY_ID	See table 146
VENDOR SPECIFIC IDENTIFIER	See table 146

The NAA field, the IEEE COMPANY_ID field, and the VENDOR SPECIFIC IDENTIFIER field shall be based on the ATA IDENTIFY DEVICE data World wide name field as described in table 146.

Table 146 — Fields in the logical unit name

Field		Contents
Field name	**Specific bits in table 145**	
NAA	Byte 4 bits 7:4	IDENTIFY DEVICE word 108 bits 15:12 [a]
IEEE COMPANY_ID	Byte 4 bits 3:0	IDENTIFY DEVICE word 108 bits 11:8
	Byte 5	IDENTIFY DEVICE word 108 bits 7:0
	Byte 6	IDENTIFY DEVICE word 109 bits 15:8
	Byte 7 bits 7:4	IDENTIFY DEVICE word 109 bits 7:4
VENDOR SPECIFIC IDENTIFIER	Byte 7 bits 3:0	IDENTIFY DEVICE word 109 bits 3:0
	Byte 8	IDENTIFY DEVICE word 110 bits 15:8
	Byte 9	IDENTIFY DEVICE word 110 bits 7:0
	Byte 10	IDENTIFY DEVICE word 111 bits 15:8
	Byte 11	IDENTIFY DEVICE word 111 bits 7:0

[a] This 4-bit field is required to be set to 5h (i.e., IEEE Registered) by ACS-3.

10.3.4.2.3 Logical unit name derived from the model number and serial number

Table 147 defines the logical unit name derived from the ATA device model number and serial number.

Table 147 — Logical unit name derived from the world wide name

Field	Description or reference
PROTOCOL IDENTIFIER	Shall be set to zero
CODE SET	Shall be set to 2h
PIV	Shall be set to zero
ASSOCIATION	Shall be set to zero
DESIGNATOR TYPE	Shall be set to 1h
DESIGNATOR LENGTH	Shall be set to 68
T10 VENDOR IDENTIFICATION	Shall be set to the string 'ATA¬¬¬¬¬'.
VENDOR SPECIFIC IDENTIFIER	See table 148

The VENDOR SPECIFIC IDENTIFIER field shall be set to a representation of the ATA IDENTIFY DEVICE data Model number field concatenated with a representation of the ATA IDENTIFY DEVICE data Serial number field as described in table 148.

Table 148 — VENDOR SPECIFIC IDENTIFIER field for logical unit name

Byte	Contents	
	Source field name	Source location
0	Model number field	IDENTIFY DEVICE word 27 bits 15:8
1		IDENTIFY DEVICE word 27 bits 7:0
2		IDENTIFY DEVICE word 28 bits 15:8
...		...
39		IDENTIFY DEVICE word 46 bits 7:0
40	Serial number field	IDENTIFY DEVICE word 10 bits 15:8
41		IDENTIFY DEVICE word 10 bits 7:0
42		IDENTIFY DEVICE word 11 bits 15:8
...		...
59		IDENTIFY DEVICE word 19 bits 7:0

NOTE 9 - The logical unit name using the T10 vendor ID based format is not guaranteed to be worldwide unique, since ACS-3 only requires the combination of the Model number field and Serial number field to be unique for a given manufacturer but defines no manufacturer identification field.

10.3.4.3 Examples of additional designation descriptors

10.3.4.3.1 Designation descriptors included by a SATL in an ATA host

Figure 13 shows the designation descriptor returned by a SATL in an ATA host (i.e., where the ATA device is being accessed with an ATA host port) containing a logical unit name based on ATA IDENTIFY DEVICE data (see table 145 or table 147 in 10.3.4.2).

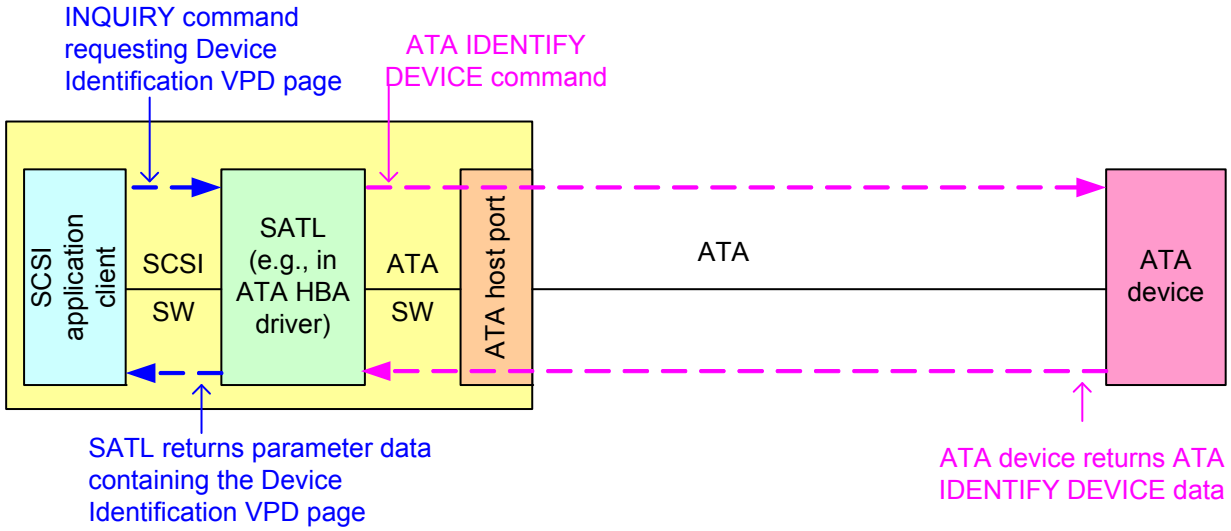

Figure 13 — Designation descriptors included by a SATL in an ATA host

10.3.4.3.2 Designation descriptors included by a SATL in a SAS initiator device

Figure 14 shows the designation descriptors returned by a SATL in a SAS initiator device (i.e., where the ATA device is being accessed by a SAS STP initiator port through an STP/SATA bridge) that contain:

a) a logical unit name based on ATA IDENTIFY DEVICE data (see table 145 or table 147 in 10.3.4.2);
b) a target port identifier based on the SAS STP target port SAS address (see table 149); and
c) a relative target port identifier set to 0001h (see SPC-4).

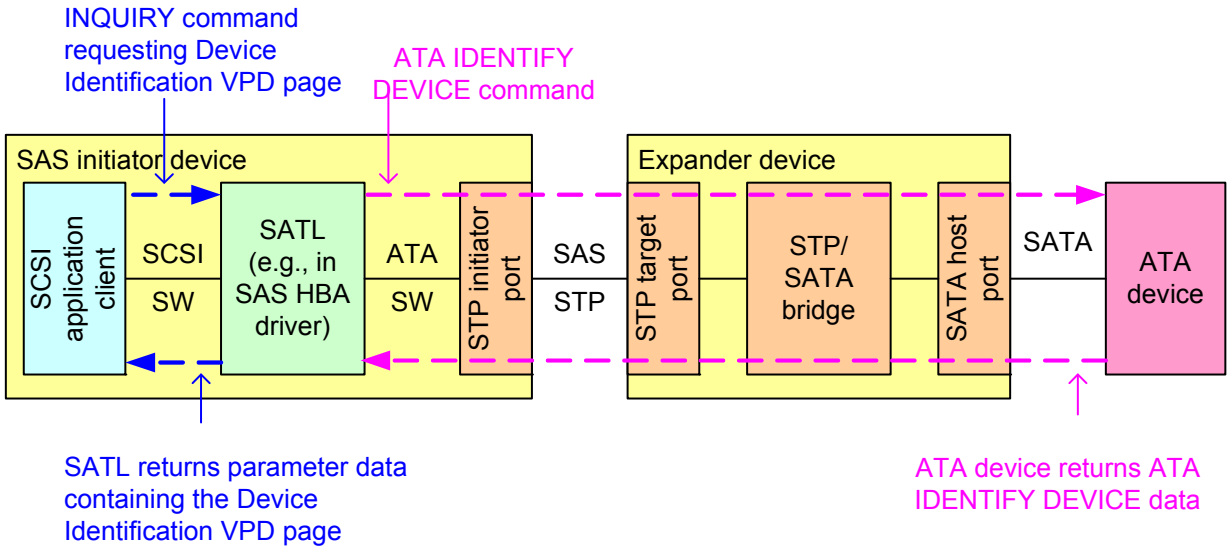

Figure 14 — Designation descriptors included by a SATL in a SAS initiator device

The SATL includes a target port identifier as defined in table 149.

Table 149 — Target port identifier for SAS

Byte\Bit	7	6	5	4	3	2	1	0
0	PROTOCOL IDENTIFIER (6h)				CODE SET (1h)			
1	PIV (1b)	Reserved	ASSOCIATION (01b)		DESIGNATOR TYPE (3h)			
2	Reserved							
3	DESIGNATOR LENGTH (08h)							
4	SAS ADDRESS							
11								

The CODE SET field is set to 1h (i.e., binary).

The PIV bit is set to one.

The ASSOCIATION field is set to 01b (i.e., target port).

The DESIGNATOR TYPE field is set to 3h (i.e., NAA).

The SAS ADDRESS field is set to the SAS address of the STP target port providing the STP/SATA bridge functionality (i.e., the SAS address of the SATA device).

10.3.4.3.3 Designation descriptors included by a SATL in a SCSI to ATA protocol bridge

Figure 15 shows the designation descriptors returned by a SATL in a SCSI to ATA protocol bridge, where the ATA device is being accessed by an ATA host port, and the SATL is being accessed with a SCSI target port using a SCSI transport protocol (e.g, FCP-3 or iSCSI) that contains:

a) a logical unit name based on ATA IDENTIFY DEVICE data (see table 145 or table 147 in 10.3.4.2);
b) any target port identifiers specified by the SCSI transport protocol standard; and
c) any other designation descriptors supported by the protocol bridge (e.g., a target device name).

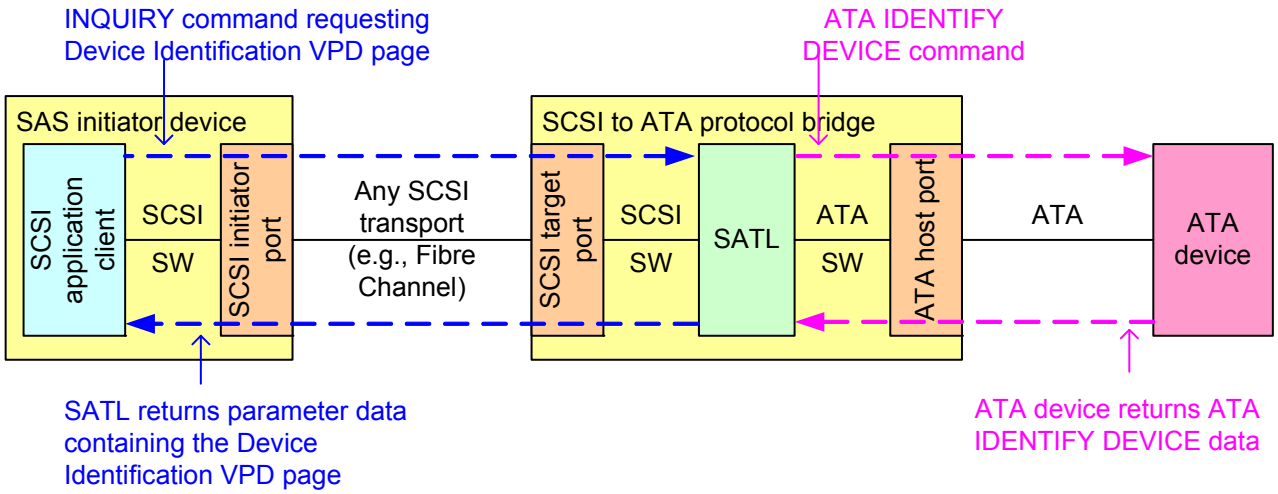

Figure 15 — Designation descriptors included by a SATL in a SCSI to ATA protocol bridge

10.3.5 Extended INQUIRY Data VPD page

Table 150 shows the translation of the fields in the Extended INQUIRY Data VPD page. If the SATL supports the READ BUFFER command (see 8.8) with the MODE field set to 1Ch (i.e., Error history mode) then the SATL shall support the Extended INQUIRY Data VPD page.

Table 150 — Extended INQUIRY Data VPD page fields

Field	Description or reference
PERIPHERAL QUALIFIER	The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2.
PERIPHERAL DEVICE TYPE	
PAGE CODE	Shall be set to 86h.
PAGE LENGTH	Shall be set to 3Ch.
RST_BEH	Shall be set to 1b.
all others	Unspecified (see 3.4.2).

10.3.6 Mode Page Policy VPD page

The SATL should implement the Mode Page Policy VPD page (see SPC-4). Table 151 defines the Mode Page Policy VPD page (see SPC-4) returned by the SATL.

Table 151 — Mode Page Policy VPD page fields

Field	Description or reference
PERIPHERAL QUALIFIER	The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2.
PERIPHERAL DEVICE TYPE	
PAGE CODE	The SATL shall set this field to 87h.
PAGE LENGTH	Unspecified (see 3.4.2).
Mode page policy descriptor	If the SATL implements the Mode Page Policy VPD page, then the SATL shall include at least one mode page policy descriptor (see table 152).

Table 152 shows the fields of the mode page policy descriptor. See 10.1.1 for recommendations on implementation of the fields in table 152.

Table 152 — Mode policy descriptor for SAT

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved		POLICY PAGE CODE					
1	POLICY SUBPAGE CODE							
2	MLUS	Reserved						MODE PAGE POLICY
3	Reserved							

The POLICY PAGE CODE field, the POLICY SUBPAGE CODE field, the multiple logical units share (i.e., MLUS) bit, and MODE PAGE POLICY field are unspecified (see 3.4.2 and SPC-4).

10.3.7 Power Condition VPD page

Table 153 shows the translation of fields in the Power Condition VPD page. This page shall only be supported by the SATL if the ATA IDENTIFY DEVICE data word 119 bit 7 (i.e., the ATA EPC (Extended Power Conditions) feature support) is set to one.

Table 153 — Power Condition VPD page field translations (part 1 of 2)

Field	Description or Reference
PERIPHERAL QUALIFIER	The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2.
PERIPHERAL DEVICE TYPE	
PAGE CODE	The SATL shall set this field to 8Ah.
PAGE LENGTH	The SATL shall set this field to 000Eh.
STANDBY_Y	The SATL shall set this bit to the value of bit seven of byte one in the Standby_y power condition descriptor of the ATA Power Conditions log.
STANDBY_Z	The SATL shall set this bit to the value of bit seven of byte one in the Standby_z power condition descriptor of the ATA Power Conditions log.
IDLE_C	The SATL shall set this bit to the value of bit seven of byte one in the Idle_c power conditions descriptor of the ATA Power Conditions log.
IDLE_B	The SATL shall set this bit to the value of bit seven of byte one in the Idle_b power conditions descriptor of the ATA Power Conditions log.
IDLE_A	The SATL shall set this bit to the value of bit seven of byte one in the Idle_a power conditions descriptor of the ATA Power Conditions log.
STOPPED CONDITION RECOVERY TIME	This field shall be set to zero.

Table 153 — Power Condition VPD page field translations (part 2 of 2)

Field	Description or Reference
STANDBY_Z CONDITION RECOVERY TIME	If the value of the Nominal Recovery Time to PM0:Active field of the Standby_z power conditions descriptor of the ATA Power Conditions Log is greater than 0000_FFFEh, then the SATL shall set the STANDBY_Z CONDITION RECOVERY TIME field to FFFFh. If the value of the Nominal Recovery Time to PM0:Active field of the Standby_z power conditions descriptor of the ATA Power Conditions Log is less than 0000_FFFFh, then the SATL shall set the STANDBY_Z CONDITION RECOVERY TIME field to the value of the Nominal Recovery Time to PM0:Active field of the Standby_z power conditions descriptor of the ATA Power Conditions Log.
STANDBY_Y CONDITION RECOVERY TIME	If the value of the Nominal Recovery Time to PM0:Active field of the Standby_y power conditions descriptor of the ATA Power Conditions Log is greater than 0000_FFFEh, then the SATL shall set the STANDBY_Y CONDITION RECOVERY TIME field to FFFFh. If the value of the Nominal Recovery Time to PM0:Active field of the Standby_y power conditions descriptor of the ATA Power Conditions Log is less than 0000_FFFFh, then the SATL shall set the STANDBY_Y CONDITION RECOVERY TIME field to the value of the Nominal Recovery Time to PM0:Active field of the Standby_y power conditions descriptor of the ATA Power Conditions Log.
IDLE_A CONDITION RECOVERY TIME	If the value of the Nominal Recovery Time to PM0:Active field of the Idle_a power conditions descriptor of the ATA Power Conditions Log is greater than 0000_FFFEh, then the SATL shall set the IDLE_A CONDITION RECOVERY TIME field to FFFFh. If the value of the Nominal Recovery Time to PM0:Active field of the Idle_a power conditions descriptor of the ATA Power Conditions Log is less than 0000_FFFFh, then the SATL shall set the IDLE_A CONDITION RECOVERY TIME field to the value of the Nominal Recovery Time to PM0:Active field of the Idle_a power conditions descriptor of the ATA Power Conditions Log.
IDLE_B CONDITION RECOVERY TIME	If the value of the Nominal Recovery Time to PM0:Active field of the Idle_b power conditions descriptor of the ATA Power Conditions Log is greater than 0000_FFFEh, then the SATL shall set the IDLE_B CONDITION RECOVERY TIME field to FFFFh. If the value of the Nominal Recovery Time to PM0:Active field of the Idle_b power conditions descriptor of the ATA Power Conditions Log is less than 0000_FFFFh, then the SATL shall set the IDLE_B CONDITION RECOVERY TIME field to the value of the Nominal Recovery Time to PM0:Active field of the Idle_b power conditions descriptor of the ATA Power Conditions Log.
IDLE_C CONDITION RECOVERY TIME	If the value of the Nominal Recovery Time to PM0:Active field of the Idle_c power conditions descriptor of the ATA Power Conditions Log is greater than 0000_FFFEh, then the SATL shall set the IDLE_C CONDITION RECOVERY TIME field to FFFFh. If the value of the Nominal Recovery Time to PM0:Active field of the Idle_c power conditions descriptor of the ATA Power Conditions Log is less than 0000_FFFFh, then the SATL shall set the IDLE_C CONDITION RECOVERY TIME field to the value of the Nominal Recovery Time to PM0:Active field of the Idle_c power conditions descriptor of the ATA Power Conditions Log.

10.3.8 Block Device Characteristics VPD page

Table 154 shows the translation of fields in the Block Device Characteristics VPD page.

Table 154 — Block Device Characteristics VPD page field translations

Field	Description or Reference
PERIPHERAL QUALIFIER	The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2.
PERIPHERAL DEVICE TYPE	
PAGE CODE	Shall be set to B1h.
PAGE LENGTH	Shall be set to 003Ch.
MEDIUM ROTATION RATE	The SATL shall set this field to the value contained in the ATA IDENTIFY DEVICE data word 217.
PRODUCT TYPE	Shall be set to 00h.
WABEREQ	Unspecified (see 3.4.2)
WACEREQ	Unspecified (see 3.4.2)
NOMINAL FORM FACTOR	The SATL shall set this field to the value contained in the ATA IDENTIFY DEVICE data word 168 bits 3:0.
ZONED	The SATL shall set this field to the value of the Zoned Capabilities field of ATA IDENTIFY DEVICE data.
FUAB	Unspecified (see 3.4.2)
VBULS	Unspecified (see 3.4.2)

10.3.9 Block Limits VPD page

Table 155 shows the translation of fields in the Block Limits VPD page.

Table 155 — Block Limits VPD Page field translations

Field or Bit	Description or reference
PERIPHERAL QUALIFIER	The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2.
PERIPHERAL DEVICE TYPE	
PAGE CODE	Shall be set to B0h.
PAGE LENGTH	Shall be set to 003Ch.
OPTIMAL TRANSFER LENGTH GRANULARITY	Unspecified (see 3.4.2)
MAXIMUM TRANSFER LENGTH	Unspecified (see 3.4.2)
OPTIMAL TRANSFER LENGTH	Unspecified (see 3.4.2)

Table 155 — Block Limits VPD Page field translations

Field or Bit	Description or reference
MAXIMUM PREFETCH XDREAD XDWRITE TRANSFER LENGTH	Unspecified (see 3.4.2)
MAXIMUM UNMAP LBA COUNT	If ATA IDENTIFY DEVICE data log TRIM SUPPORTED bit is set to one and ATA IDENTIFY DEVICE data log DRAT SUPPORTED bit is set to one, then this field is unspecified (see 3.4.2); otherwise, the value of this field shall be set to zero.
MAXIMUM UNMAP BLOCK DESCRIPTOR COUNT	If ATA IDENTIFY DEVICE data log TRIM SUPPORTED bit is set to one and ATA IDENTIFY DEVICE data log DRAT SUPPORTED bit is set to one, then this field is unspecified (see 3.4.2); otherwise, the value of this field shall be set to zero.
OPTIMAL UNMAP GRANULARITY	If ATA IDENTIFY DEVICE data log TRIM SUPPORTED bit is set to one and ATA IDENTIFY DEVICE data log DRAT SUPPORTED bit is set to one, then this field is unspecified (see 3.4.2); otherwise, the value of this field shall be set to zero.
UGAVALID	If ATA IDENTIFY DEVICE data log TRIM SUPPORTED bit is set to one and ATA IDENTIFY DEVICE data log DRAT SUPPORTED bit is set to one, then this field is unspecified (see 3.4.2); otherwise, the value of this field shall be set to zero.
UNMAP GRANULARITY ALIGNMENT	If ATA IDENTIFY DEVICE data log TRIM SUPPORTED bit is set to one and ATA IDENTIFY DEVICE data log DRAT SUPPORTED bit is set to one, then this field is unspecified (see 3.4.2); otherwise, the value of this field shall be set to zero.
MAXIMUM WRITE SAME LENGTH	Unspecified (see 3.4.2)

NOTE 10 - The MAXIMUM UNMAP LBA COUNT field may be set to the value of ATA IDENTIFY DEVICE data word 105 times 4 194 240 (4 194 240 = 64 entries per 512 byte unit times 65 535 contiguous blocks per entry). The MAXIMUM UNMAP BLOCK DESCRIPTOR COUNT may be set to the value of ATA IDENTIFY DEVICE data word 105 times 64.

10.3.10 Logical Block Provisioning VPD page

Table 156 shows the translation of fields in the Logical Block Provisioning VPD page.

Table 156 — Logical Block Provisioning VPD Page field translations

Field or Bit	Description or reference
PERIPHERAL QUALIFIER	The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2.
PERIPHERAL DEVICE TYPE	
PAGE CODE	Shall be set to 00B2h.
PAGE LENGTH	If the SATL implements a resource descriptor, then this field is unspecified (see 3.4.2), otherwise this field shall be set to 04h.

Table 156 — Logical Block Provisioning VPD Page field translations

Field or Bit	Description or reference
THRESHOLD EXPONENT	If the SATL implements thresholds, then this field is unspecified (see 3.4.2), otherwise, this field shall be set to zero.
LBPU	If the UNMAP command is translated as specified in 9.19, then this bit shall be set to one. Otherwise, this bit shall be set to zero.
LBPWS	If the SATL translation of a WRITE SAME (16) command with unmap bit set to one results in an ATA DATA SET MANAGEMENT command with the TRIM bit set to one, as specified in 9.34, then this bit shall be set to one. Otherwise, this bit shall be set to zero.
LBPWS10	If the SATL translation of a WRITE SAME (10) command with unmap bit set to one results in an ATA DATA SET MANAGEMENT command with the TRIM bit set to one, as specified in 9.34, then this bit shall be set to one. Otherwise, this bit shall be set to zero.
LBPRZ	If the ATA IDENTIFYDEVICE data log TRIM SUPPORTED bit is set to one and the ATA IDENTIFY DEVICE data log RZAT SUPPORTED bit is set to one, then this bit shall be set to one. Otherwise, this bit shall be set to zero.
ANC_SUP	If ATA IDENTIFY DEVICE data log TRIM SUPPORTED bit is set to one and ATA IDENTIFY DEVICE data log DRAT SUPPORTED bit is set to one, then this field shall be set to one, otherwise, this field is unspecified (see 3.4.2).
DP	If the SATL implements a resource descriptor, then this field is unspecified (see 3.4.2), otherwise this field shall be set to zero.

10.3.11 Zoned Block Device Characteristics VPD page

Table 157 shows the translation of fields in the Zoned Block Device Characteristics VPD page.This page shall be supported if the device is either an ATA host aware zoned device (see 3.1.16) or an ATA host managed zoned device (see 3.1.17).

Table 157 — Zoned Block Device Characteristics VPD page field translations

Field	Description or Reference
PERIPHERAL QUALIFIER	The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2.
PERIPHERAL DEVICE TYPE	
PAGE CODE	Shall be set to B6h.
PAGE LENGTH	Shall be set to 003Ch.

Table 157 — Zoned Block Device Characteristics VPD page field translations

Field	Description or Reference
URSWRZ	Shall be set to the value of the URSWRZ field in the Zoned Device Information page of theATA IDENTIFY DEVICE log (see ZAC).
OPTIMAL NUMBER OF OPEN SEQUENTIAL WRITE PREFERRED ZONES	Shall be set to the value of the OPTIMAL NUMBER OF OPEN SEQUENTIAL WRITE PREFERRED ZONES field in the Zoned Device Information page of the ATA IDENTIFY DEVICE log (see ZAC).
OPTIMAL NUMBER OF NON-SEQUENTIALLY WRITTEN SEQUENTIAL WRITE PREFERRED ZONES	Shall be set to the value of the OPTIMAL NUMBER OF NON-SEQUENTIALLY WRITTEN SEQUENTIAL WRITE PREFERRED ZONES field in the Zoned Device Information page of the ATA IDENTIFY DEVICE log (see ZAC).
MAXIMUM NUMBER OF OPEN SEQUENTIAL WRITE REQUIRED ZONES	Shall be set to the value of the MAXIMUM NUMBER OF OPEN SEQUENTIAL WRITE REQUIRED ZONES field in the Zoned Device Information page of the ATA IDENTIFY DEVICE log (see ZAC).

11 Translation of ATA errors to SCSI errors

11.1 Overview

Unless otherwise specified in the subclause describing the translation of a particular SCSI command, log page, mode page or VPD page, the SATL shall translate ATA commands that complete with an error to SCSI errors as shown in table 158.

Table 158 — ATA to SCSI Error Translation

Command encountering an error	Feature settings	Reference
ATA NCQ Command	ATA NCQ Autosense is supported (i.e., the NCQ AUTOSENSE SUPPORTED bit is set to one in the ATA IDENTIFY DEVICE data log.)	11.2
	ATA NCQ Autosense is not supported (i.e., the NCQ AUTOSENSE SUPPORTED bit is set to zero in the ATA IDENTIFY DEVICE data log.)	11.3
ATA non-NCQ command	a) ATA Sense Data Reporting feature set enabled (i.e., the SENSE DATA ENABLED bit in the ATA IDENTIFY DEVICE data log is set to one)(see 5.4); b) ATA Sense Data Available bit in the ATA Status field is set to one; and c) The ERR bit in the ATA Status field is set to one	11.4
	All others	11.5

11.2 ATA NCQ autosense error translation

The SCSI SENSE KEY field shall be set to byte 14 of the ATA Queued Error log, the SCSI ADDITIONAL SENSE CODE field shall be set to byte 15, and the SCSI ADDITIONAL SENSE CODE QUALIFIER field shall be set to byte 16 for error reporting.

11.3 ATA NCQ no autosense error translation

The SATL shall translate the error to the appropriate SCSI error using the translation described in 11.5 as if :

a) the ATA Status field was set to the contents of byte two of the ATA Queued Error log; and
b) the ATA Error field was set to the contents of byte three of the ATA Queued Error log.

11.4 ATA sense data available with ATA error translation

To translate an ATA error with sense data available, the SATL shall send an ATA REQUEST SENSE DATA EXT command to the ATA device.

If the ATA REQUEST SENSE DATA EXT command:

a) completes without error, then the SATL shall set the SENSE KEY field to the value contained in ATA LBA field bits 19:16, ADDITIONAL SENSE CODE field to the value contained in ATA LBA field bits 15:8 and ADDITIONAL SENSE CODE QUALIFIER field to the value contained in ATA LBA field bits 7:0; or
b) completes with error, then the SATL shall translate the original ATA device command error,as described in11.5.

11.5 ATA Fixed error translation

The ATA Status field and Error field bit settings provide the information to be translated into SCSI sense key, additional sense code, and additional sense code qualifier for error reporting as shown in table 159.

Table 159 — Fixed Translation of ATA errors to SCSI errors

ATA Error Field		SCSI Error	
Status	**Error** [a]	**Sense key**	**Additional sense code**
DF [b]	n/a	HARDWARE ERROR	INTERNAL TARGET FAILURE
ERR	NM	NOT READY	MEDIUM NOT PRESENT
ERR	UNC	MEDIUM ERROR	UNRECOVERED READ ERROR
ERR	WP	DATA PROTECT	WRITE PROTECTED
ERR	IDNF	ILLEGAL REQUEST[d]	LOGICAL BLOCK ADDRESS OUT OF RANGE[d]
ERR	ABRT [c]	ABORTED COMMAND	NO ADDITIONAL SENSE INFORMATION
ERR	MC	UNIT ATTENTION	NOT READY TO READY CHANGE, MEDIUM MAY HAVE CHANGED
ERR	MCR	UNIT ATTENTION	OPERATOR MEDIUM REMOVAL REQUEST
ERR	ICRC	ABORTED COMMAND	INFORMATION UNIT iuCRC ERROR DETECTED
CORR	n/a	This condition is not considered an error.	

[a] If the Error field has an obsolete bit set to one, then the SATL may return a vendor-specific additional sense code (e.g., if the AMNF bit is set to one, return a sense key of MEDIUM ERROR, with additional sense code of ADDRESS MARK NOT FOUND FOR DATA FIELD).
[b] After an ATA device returns a DF bit set to one, the SATL processes any subsequent commands received for the logical unit corresponding to the ATA device by terminating the command with CHECK CONDITION status with the sense key set to HARDWARE ERROR and the additional sense code set to INTERNAL TARGET FAILURE.
[c] The ABRT bit is ignored if any other ATA error bit is set.
[d] SATLs compliant with versions of this standard prior to SAT-2 return a sense key of MEDIUM ERROR and an additional sense code of RECORD NOT FOUND.

12 SAT-specific SCSI extensions

12.1 SAT-specific SCSI extensions overview

This clause defines additional SCSI commands, mode pages, security protocols, and VPD pages that may be supported by a SATL to provide capabilities beyond those defined in the other SCSI command sets.

SCSI commands defined for SATL implementations include:

a) ATA PASS-THROUGH (12) command (see 12.2.2.2); and
b) ATA PASS-THROUGH (16) command (see 12.2.2.3).

Mode pages defined for SATL implementations include:

a) PATA Control mode page (see 12.3.2); and
b) ATA Power Condition mode page (see 12.3.3).

VPD pages defined for SATL implementations include:

a) ATA Information VPD page (see 12.4.2).

Security protocols defined for SATL implementations include:

a) ATA Device Server Password security protocol (see 12.5.1).

Log pages defined for SATL implementations include:

a) ATA PASS-THROUGH Results log page (see 12.6.2).

12.2 SAT-specific commands

12.2.1 SAT-specific commands overview

This subclause describes commands that the SATL may implement that are unique to the SCSI / ATA Translation standard. These commands are for use by the SATL, are shown in table 160 and are described in this subclause.

Table 160 — SCSI / ATA Translation specific commands

Command name	Operation code	Type	Protection Information	Reference
ATA PASS-THROUGH (12)	A1h	O	no	12.2.2.2
ATA PASS-THROUGH (16)	85h	O	no	12.2.2.3

12.2.2 ATA PASS-THROUGH commands

12.2.2.1 ATA PASS-THROUGH commands overview

ATA PASS-THROUGH commands provide a method for:

a) an application client to transmit an ATA command to an ATA device;
b) optionally, transferring data between an application client and an ATA device; and
c) an ATA device to transfer completion status through the SATL.

This is accomplished by defining:

a) CDBs containing ATA command information (see 12.2.2.2 and 12.2.2.3); and

b) specific SCSI status and sense data usage for returning the results of an ATA command (see 12.2.2.5 and 12.2.2.7).

If the SATL supports the ATA PASS-THROUGH (12) command or the ATA PASS-THROUGH (16) command, then the SATL shall support the ATA Status Return descriptor (see 12.2.2.6).

The SATL shall process all ATA PASS-THROUGH commands regardless of the emulated SCSI power condition (e.g., stopped power condition).

12.2.2.2 ATA PASS-THROUGH (12) command

Table 161 shows the CDB for the ATA PASS-THROUGH (12) command.

Table 161 — ATA PASS-THROUGH (12) command

Byte\Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (A1h)							
1	MULTIPLE_COUNT			PROTOCOL				Reserved
2	OFF_LINE		CK_COND	T_TYPE	T_DIR	BYTE_BLOCK	T_LENGTH	
3	FEATURES (7:0)							
4	COUNT (7:0)							
5	LBA (7:0)							
6	LBA(15:8)							
7	LBA (23:16)							
8	DEVICE							
9	COMMAND							
10	Reserved							
11	CONTROL (see 6.5)							

12.2.2.4 table 168 describes the mapping between the fields in the ATA PASS-THROUGH (12) CDB to corresponding ATA command fields (see ACS- 3).

The operation code field is set to A1h.

The MULTIPLE_COUNT field specifies the logarithm base 2 of the number of logical sectors an ATA host shall transfer per DRQ Data Block (e.g, if the field is set to 4, the SATL shall transfer 2^4 (i.e., 16) logical sectors of data in each DRQ Data Block). If the MULTIPLE_COUNT field is nonzero and the COMMAND field is not an ATA READ MULTIPLE command, ATA READ MULTIPLE EXT command, ATA WRITE MULTIPLE command, ATA WRITE MULTIPLE EXT command, or ATA WRITE MULTIPLE FUA EXT command, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

If the SATL receives an ATA PASS-THROUGH (12) command, then the SATL shall check the PROTOCOL field (see table 162) to determine the type of action requested.

Table 162 — PROTOCOL field

Code	Description
0h	Device Management - ATA hardware reset
1h	Device Management - ATA software reset
2h	Reserved
3h	Non-Data
4h	PIO Data-In
5h	PIO Data-Out
6h	DMA
7h	Reserved
8h	Execute Device Diagnostic
9h	Non-data command - Device Reset
Ah	UDMA Data In
Bh	UDMA Data Out
Ch	FPDMA [a]
Dh, Eh	Reserved
Fh	Return Response Information

[a] See SATA 3.1.

The PROTOCOL field specifies the protocol to use when the ATA device processes the command. ATA8-AAM defines the meaning of protocol values ranging from 0h to Bh.

If the PROTOCOL field is set to 0h, (i.e., Device Management - ATA hardware reset) and the device is a PATA device, then the SATL shall assert RST- (see ATA8-APT). If the PROTOCOL field is set to zero (i.e., Device Management - ATA hardware reset) and the device is a SATA device, then the SATL shall send a COMRESET to the SATA device. If the PROTOCOl field is set to 0h, only the PROTOCOL field and the OFF_LINE field are valid. The SATL shall ignore all other fields in the CDB.

If the PROTOCOL field is set to 1h, (i.e., Device Management - ATA software reset) then the SATL shall send a software reset to the ATA device (see ATA8-AAM). If the PROTOCOL field is set to 1h (i.e., Device Mangement - ATA software reset), only the PROTOCOL field and the OFF_LINE field are valid. The SATL shall ignore all other fields in the CDB.

If the PROTOCOL field specified is in the range from 3h to Ch, then the SATL shall send an ATA command specified by the CDB to the ATA device.

If the PROTOCOL field contains Fh (i.e., Return Response Information), then the SATL shall:

1) ignore all fields in the CDB except for the PROTOCOL field;
2) read the ATA Command Block as follows:

A) if the transport is SATA, read the current Shadow Command Block registers; or
B) if the transport is PATA, read the current Command Block registers; and

3) return the contents of the ATA Command Block in the ATA Status Return Descriptor as defined in 12.2.2.6.

If the value in the PROTOCOL field is inappropriate for the command specified in the COMMAND field (see ACS-3), then the SATL may lose communication with the ATA device. This standard does not specify the SATL behavior if this occurs.

If the value in the PROTOCOL field requests the SATL to send a command to the ATA device, then the SATL shall set the fields in the ATA command using fields in the ATA PASS-THROUGH CDB as shown in table 168.

The OFF_LINE field specifies the time period during which the ATA Status field may be invalid after command acceptance. In a SATL with a PATA device attached, some commands may cause the PATA device to place the ATA bus in an indeterminate state. This may cause the ATA host to see command completion before the command is completed. If the application client sends a command that is capable of placing the bus in an indeterminate state, it shall set the OFF_LINE field to a value that specifies the maximum number of seconds from the time a command is sent until the ATA Status field is valid. The SATL shall not use the ATA Status field to determine ATA command completion status until this time has elapsed. The valid status is available (2^{off_line+1} - 2) seconds (i.e., 0, 2, 6, and 14 seconds) after the Command field is stored.

NOTE 11 - If the application client specifies an off_line value that is too small, then the results are indeterminate and may compromise the integrity of the data.

The CK_COND (Check Condition) bit may be used to request the SATL to return a copy of ATA field information in the sense data upon command completion. If the CK_COND bit is set to one then the SATL shall return a status of CHECK CONDITION when the ATA command completes, even if the command completes successfully and return sense data as specified in table 163. If the CK_COND bit is set to zero, then the SATL shall terminate the command with CHECK CONDITION status only if an error occurs in processing the command. See clause 11 for a description of ATA error conditions.

Table 163 — Returned sense data with CK_COND set to one

PROTOCOL	D_SENSE [a]	Returned sense data
PIO Data-in FPDMA	1	ATA Return descriptor as described in 12.2.2.6 with bytes 3 through 13 set to zero.
	0	Fixed format sense data as described in 12.2.2.7 with the INFORMATION field set to zero and the COMMAND-SPECIFIC INFORMATION field set to zero.
All others	1	ATA Return descriptor as described in 12.2.2.6.
	0	Fixed format sense data as described in 12.2.2.7.

[a] The D_SENSE bit in the Control mode page (see 10.1.6)

The SATL shall determine if a data transfer is necessary and how to perform the data transfer by examining values in the MULTIPLE_COUNT field, PROTOCOL field, OFF_LINE field, T_DIR bit, T_TYPE bit, BYTE_BLOCK bit, and T_LENGTH field. The SATL shall ignore the COMMAND field in the CDB except to copy the COMMAND field in the CDB to the Command field in the Register – Host to Device FIS or to the ATA Command field. If the ATA command completes with an error, then the SATL shall return the Error Output fields (see ACS-3) in the sense data.

The SATL shall configure the ATA host and the ATA device for the PIO, DMA, and UDMA transfer rates that both the SATL and ATA device support. The SATL should set the transfer rates to the maximum supported by both the SATL and the ATA device. The ATA PASS-THROUGH (12) command should not be used to send an ATA SET

FEATURES command that changes the PIO/DMA/UDMA or other transfer modes of the ATA device. The result of an ATA SET FEATURES command that changes the PIO/DMA/UDMA or other transfer modes of the ATA device is outside the scope of this standard and may cause communication to be lost with the ATA device; thus preventing the SATL from performing any action based on the contents of the CDB.

The Byte / Block (BYTE/BLOCK) bit is as specified in table 165.

The DEVICE field specifies a value for the SATL to load into the ATA Device field. Table 164 shows the bits in the DEVICE field.

Table 164 — ATA PASS-THROUGH (12) command and ATA PASS-THROUGH (16) command DEVICE field

Bit							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Obsolete	Command Specific	Obsolete	DEV	Command Specific			

The SATL shall ignore the DEV bit in the DEVICE field of the CDB.

The SATL shall set the value of the DEV bit in the ATA device register based upon the SATL mapping of ATA devices to I_T_L nexuses.

If the PROTOCOL field specifies a PIO data transfer, then the SATL shall perform a PIO type transfer. If the transfer direction (T_DIR) bit and the direction of the data transfer specified in the PROTOCOL field do not match, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

If the T_DIR bit is set to zero, then the SATL shall transfer data from the application client to the ATA device. If the T_DIR bit is set to one, then the SATL shall transfer data from the ATA device to the application client. The SATL shall ignore the T_DIR bit if the T_LENGTH field is set to zero.

The transfer type (T_TYPE) bit is as specified in table 165.

The transfer length (T_LENGTH) field specifies where in the CDB the SATL shall locate the transfer length for the command (see table 165 and table 166).

Table 165 — Mapping of BYTE_BLOCK, T_TYPE, and T_LENGTH fields

BYTE_BLOCK	t_type	t_length	Transfer length in the location specified by the t_length field specifies
1	0	non-zero	The number of 512 byte blocks to be transferred
1	1	non-zero	The number of ATA logical sector size (see 3.1.19) blocks to be transferred
0	all	non-zero	The number of bytes to be transferred
all	all	zero	No data is transferred

Table 166 — T_LENGTH field

Code	Description
00b	No data is transferred
01b	The transfer length is an unsigned integer specified in the FEATURES (7:0) field.
10b	The transfer length is an unsigned integer specified in the SECTOR_COUNT (7:0) field.
11b	The transfer length is an unsigned integer specified in the TPSIU (see 3.1.99).

See 12.2.2.4 for a description of the mapping from the FEATURES (7:0) field, the SECTOR_COUNT (7:0) field, the LBA (7:0) field, the LBA (7:0) field, the LBA (7:0) field, the DEVICE field, and the COMMAND field in the ATA PASS-THROUGH (12) CDB to corresponding ATA command fields (see ACS-3).

12.2.2.3 ATA PASS-THROUGH (16) command

Table 167 shows the format of the ATA PASS-THROUGH (16) command.

Table 167 — ATA PASS-THROUGH (16) command

Byte\Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (85h)							
1	MULTIPLE_COUNT			PROTOCOL				EXTEND
2	OFF_LINE		CK_COND	T_TYPE	T_DIR	BYTE_BLOCK	T_LENGTH	
3	FEATURES (15:8)							
4	FEATURES (7:0)							
5	COUNT (15:8)							
6	COUNT (7:0)							
7	LBA (31:24)							
8	LBA (7:0)							
9	LBA (39:32)							
10	LBA (15:8)							
11	LBA (47:40)							
12	LBA (23:16)							
13	DEVICE							
14	COMMAND							
15	CONTROL (see 6.5)							

If the EXTEND bit is set to zero, then the FEATURES (15:8) field, the COUNT (15:8) field, the LBA(31:24) field, the LBA(39:32) field, and the LBA(47:40) field shall be ignored by the SATL, and the SATL shall process this command as specified in 12.2.2.2.

If the EXTEND bit is set to one, then the FEATURES (15:8) field, the COUNT (15:8) field, the LBA(31:24) field, the LBA(39:32) field, and the LBA(47:40) field are valid, and the SATL shall process this command as specified in 12.2.2.2 except as described in the remainder of this subclause.

If the EXTEND bit is set to one and the value in the PROTOCOL field requests the SATL to send an ATA command to the device, then the SATL shall send a 48 bit ATA command to the ATA device.

See 12.2.2.2 for a description of the MULTIPLE_COUNT field, the PROTOCOL field, the OFF_LINE field, the CK_COND bit, the T_DIR bit, the T_TYPE bit, and the BYTE_BLOCK bit.

See 12.2.2.4 for a description of the mapping from the FEATURES (15:8) field, the FEATURES (7:0) field, the COUNT (15:8) field, the COUNT (7:0) field, the LBA fields, the DEVICE field, and the COMMAND field in the ATA PASS-THROUGH (16) CDB to corresponding ATA command fields (see ACS-3).

12.2.2.4 ATA PASS-THROUGH CDB field translations

Table 168 shows the mapping between the fields in the ATA PASS-THROUGH (12) CDB and the ATA PASS-THROUGH (16) CDB to corresponding ATA command fields (see ATA8-ACS).

Table 168 — Mapping of ATA PASS-THROUGH CDB fields to ATA command fields

CDB field	48-bit ATA command field [a]	28-bit ATA command field [b]
FEATURES (15:8)	FEATURE (15:8)	n/a
FEATURES (7:0)	FEATURE (7:0)	FEATURE (7:0)
COUNT (15:8)	COUNT (15:8)	n/a
COUNT (7:0)	COUNT (7:0)	COUNT (7:0)
LBA (31:24)	LBA (31:24)	n/a
LBA (7:0)	LBA (7:0)	LBA (7:0)
LBA (39:32)	LBA (39:32)	n/a
LBA (15:8)	LBA (15:8)	LBA (15:8)
LBA (47:40)	LBA (47:40)	n/a
LBA (23:16)	LBA (23:16)	LBA (23:16)
DEVICE (7:4)	DEVICE (7:4)	DEVICE (7:4)
DEVICE (3:0)	DEVICE (3:0)	LBA (27:24)
COMMAND	COMMAND	COMMAND

a The 48-bit ATA command translation applies only to the ATA PASS-THROUGH (16) command with EXTEND set to one, and not to the ATA PASS-THROUGH (12) command.

b The 28-bit ATA command translation may apply to either the ATA PASS-THROUGH (12) command or the ATA PASS-THROUGH (16) command with EXTEND set to zero.

The SATL shall determine the transfer length by the method specified in the T_LENGTH and EXTEND fields as shown in table 169.

Table 169 — EXTEND bit and T_LENGTH field

EXTEND	T_LENGTH	Description
0	00b	No data is transferred.
	01b	The transfer length is an unsigned integer specified in the FEATURES (7:0) field.
	10b	The transfer length is an unsigned integer specified in the SECTOR_COUNT (7:0) field.
	11b	The transfer length is an unsigned integer specified in the TPSIU (see 3.1.99).

Table 169 — EXTEND bit and T_LENGTH field

EXTEND	T_LENGTH	Description
1	00b	No data is transferred.
	01b	The transfer length is an unsigned integer specified in the FEATURES (7:0) field and the FEATURES (15:8) field.
	10b	The transfer length is an unsigned integer specified in the SECTOR_COUNT (7:0) field and the SECTOR_COUNT (15:8) field.
	11b	The transfer length is an unsigned integer specified in the TPSIU (see 3.1.99) ~~STPSIU field~~.

12.2.2.5 ATA PASS-THROUGH status return

Table 170 shows the possible results of ATA PASS-THROUGH (12) command or ATA PASS-THROUGH (16) command processing depending on the value of the CK_COND bit in the CDB, as reflected in the ERR bit and the DF bit in the ATA Status field.

Table 170 — ATA command results

CK_COND	Status field		Sense data returned
	ERR	DF	
0	0	0	No error, successful completion or command in progress. The SATL shall return GOOD status.
1			No error, successful completion or command in progress. The SATL shall terminate the command with CHECK CONDITION status with the sense key set to RECOVERED ERROR with the additional sense code set to ATA PASS-THROUGH INFORMATION AVAILABLE (see SPC-4). Descriptor format sense data shall include the ATA Status Return Descriptor (see 12.2.2.6) [a].
n/a	n/a	1	The ATA command completed with an error. The SATL shall terminate the command with CHECK CONDITION status with the sense key and additional sense code set as described in clause 11. Descriptor format sense data shall include the ATA Status Return Descriptor (see 12.2.2.6).
	1	0	

[a] This capability allows the host to retrieve the ATA field information with successful command completion by returning data in the ATA fields.

ATA commands may return information in the ATA fields or the Shadow Command Block. The current ATA field information may be retrieved by requesting the ATA Status Return Descriptor issuing the ATA PASS-THROUGH (12) command or ATA PASS-THROUGH (16) command with the PROTOCOL field set to 15 (i.e., Return Response Information).

12.2.2.6 ATA Status Return descriptor

Table 171 shows the format of the ATA Return descriptor.

Each time the ATA Return descriptor is requested, the SATL shall read the ATA fields and return those values in the sense data as shown in table 171. If the sense data is for an ATA PASS-THROUGH (12) command or for the ATA PASS-THROUGH (16) command with the EXTEND bit set to zero, then the SATL shall return the 28-bit extended status and shall set the EXTEND bit to zero.

If the sense data is for an ATA PASS-THROUGH (16) command with the EXTEND bit set to one, then the SATL shall return the 48-bit extended status and shall set the EXTEND bit to one.

Table 171 — ATA Return descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	DESCRIPTOR CODE (09h)							
1	ADDITIONAL DESCRIPTOR LENGTH (0Ch)							
2	Reserved							EXTEND
3	ERROR							
4	COUNT (15:8)							
5	COUNT (7:0)							
6	LBA (31:24)							
7	LBA (7:0)							
8	LBA (39:32)							
9	LBA (15:8)							
10	LBA (47:40)							
11	LBA (23:16)							
12	DEVICE							
13	STATUS							

An EXTEND bit set to one indicates that the sense data is for an ATA PASS-THROUGH (16) command with the EXTEND bit set to one. An EXTEND bit set to zero indicate that the sense data is for an ATA PASS-THROUGH (16) command with the EXTEND bit set to zero or for an ATA PASS-THROUGH (12) command.

If the EXTEND bit is set to one, the COUNT (15:8) field, the LBA (31:24) field, the LBA (37:32) field, and the LBA (47:40) field are not returned in the fixed format sense data.

If the EXTEND bit is set to one, then the COUNT (7:0) field and COUNT (15:8) field indicate the ATA Sector Count. If the EXTEND bit is set to zero, then the COUNT (7:0) field indicates the ATA Sector Count and COUNT (15:8) field should be ignored.

If the EXTEND bit is set to one, then the LBA (7:0) field, LBA (15:8) field, LBA (23:16) field, LBA (31:24) field, LBA (39:32) field, and LBA (47:40) field specify the ATA LBA. If the EXTEND bit is set to zero, then the LBA (7:0) field, LBA (15:8) field, and LBA (7:0) field indicate the ATA LBA, and the LBA (31:24) field, LBA (39:32) field, and LBA (47:40) field shall be set to zero.

12.2.2.7 Fixed format sense data

Table 172 shows the fields returned in the fixed format sense data (see SPC-4) for the ATA PASS-THROUGH commands.

Table 172 — Fixed format sense data fields for ATA PASS-THROUGH

Field	Descriptor or reference
VALID	Unspecified (see 3.4.2)
RESPONSE CODE	Unspecified (see 3.4.2)
FILEMARK	Set to zero
EOM	Set to zero
ILI	Set to zero
SENSE KEY	Unspecified (see 3.4.2)
INFORMATION	Table 173
ADDITIONAL SENSE LENGTH	Unspecified (see 3.4.2)
COMMAND-SPECIFIC INFORMATION	Table 174
ADDITIONAL SENSE CODE	Unspecified (see 3.4.2)
ADDITIONAL SENSE CODE QUALIFIER	Unspecified (see 3.4.2)
FIELD REPLACEABLE UNIT CODE	Unspecified (see 3.4.2)
SKSV	Unspecified (see 3.4.2)
SENSE-KEY SPECIFIC	Unspecified (see 3.4.2)
Additional sense bytes	Unspecified (see 3.4.2)

[a] SATLs compliant with versions prior to SAT-2 return descriptor format sense data for the ATA PASS-THROUGH commands regardless of the setting of the D_SENSE bit.

Table 173 defines the INFORMATION field.

Table 173 — Fixed format sense data INFORMATION field for the ATA PASS-THROUGH commands

Byte\Bit	7	6	5	4	3	2	1	0
0	ERROR							
1	STATUS							
2	DEVICE							
3	COUNT (7:0)							

Table 174 defines the COMMAND-SPECIFIC INFORMATION field.

Table 174 — Fixed format sense data COMMAND-SPECIFIC INFORMATION field for ATA PASS-THROUGH

Byte\Bit	7	6	5	4	3	2	1	0
0	EXTEND	COUNT UPPER NONZERO	LBA UPPER NONZERO	Reserved	LOG INDEX			
1	LBA (7:0)							
2	LBA (15:8)							
3	LBA (23:16)							

An EXTEND bit set to one indicates that the sense data is for an ATA PASS-THROUGH (16) command with the EXTEND bit set to one. An EXTEND bit set to zero indicates that the sense data is for an ATA PASS-THROUGH (16) command with the EXTEND bit set to zero or for an ATA PASS-THROUGH (12) command.

If the EXTEND bit is set to one, then the COUNT (15:8) field, the LBA (31:24) field, the LBA (39:32) field; and the LBA (47:40) field are not able to be returned in fixed format sense data.

If the LBA UPPER NONZERO bit is set to one, then one or more of the LBA (31:24) field, the LBA (39:32) field, and the LBA (47:40) field returned by the ATA device were not set to 00h. If the LBA UPPER NONZERO bit is set to zero, then the LBA (31:24) field, the LBA (39:32) field, and the LBA (47:40) field returned by the ATA device were each set to 00h.

If the COUNT UPPER NONZERO bit is set to one, then the COUNT (15:8) field returned by the ATA device was not set to 00h. If the SECTOR_COUNT UPPER NONZERO bit is set to zero, then the COUNT (15:8) field returned by the ATA device was set to 00h.

A LOG INDEX field set to a nonzero value indicates that the device server has logged the descriptor format sense data for the command for retrieval via the ATA PASS-THROUGH Results log page (see 12.6.2) with a parameter code set to log index minus 1 (e.g., log index 1h corresponds to parameter code 0h, and log index Fh corresponds to parameter code Eh). A LOG INDEX field set to 0h indicates that the device server has not logged the descriptor format sense data for the command for retrieval via the ATA PASS-THROUGH Results log page.

The device server:

a) should log the descriptor format sense data if the LBA UPPER NONZERO bit is set to one or the COUNT UPPER NONZERO bit is set to one;
b) shall not log the descriptor format sense data if the LBA UPPER NONZERO bit is set to zero and the COUNT UPPER NONZERO bit is set to zero;
c) shall select the log index as the previously reported log index plus one, wrapping from Fh to 0h.

12.3 SAT-specific mode pages

12.3.1 SAT-specific mode pages overview

This subclause describes mode pages that the SATL may implement that are unique to the SCSI / ATA Translation standard. These mode pages are for use by the SATL, are shown in table 175 and are described in this subclause.

Table 175 — SAT-specific mode pages

PAGE CODE	SUBPAGE CODE	Mode page name
0Ah	F1h	PATA Control [a]
1Ah	F1h	ATA Power Condition

[a] Support of the PATA Control mode page is mandatory for SATLs implementing a PATA interface.

12.3.2 PATA Control mode page

The PATA Control mode page provides PATA specific controls for a SATL to configure the underlying PATA host and to understand what parameters are communicated to the PATA device to ensure proper communication for specific transfer rates. This standard specifies the mode parameters that are provided for this mode page.

SATL implementations that support the attachment of PATA devices shall support this mode page. The SATL should allow application clients to configure alternate PATA timings using the MODE SELECT command.

Table 176 shows the PATA Control mode page.

Table 176 — PATA Control mode page

Byte\Bit	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (0Ah)					
1	SUBPAGE CODE (F1h)							
2	(MSB)	PAGE LENGTH (0004h)						
3								(LSB)
4	Reserved	MWDMA [a] bits			Reserved		PIO [b] bits	
		MWD2	MWD1	MWD0			PIO4	PIO3
5	Reserved	UDMA [c] bits						
		UDMA6	UDMA5	UDMA4	UDMA3	UDMA2	UDMA1	UDMA0
6		Reserved						
7								

[a] The Multi-Word Direct Memory Access (MWDMA) bits specify a number of hardware-assisted data transfer modes defined in ATA8-APT.
[b] PIO stands for Programmed Input and Output and the PIOx bits specify transfer modes performed under program control defined in ATA8-APT.
[c] The Ultra Direct Memory Access (UDMA) bits represent a number of hardware-assisted data transfer modes defined in ATA8-APT.

SATL implementations may save the state of the timing parameters defined in this mode page.

Application clients may use the MODE SENSE command for changeable values to determine the underlying ATA host support for a given ATA timing mode. The SATL shall support changeable mode parameters for this mode page.

If processing a MODE SENSE command, the SATL shall set the PIO3 bit and PIO4 bit as shown in table 177 to identify the configured PIO mode.If changeable values are requested, the PIO3 bit and the PIO4 bit indicate if the

Table 177 — PIO modes

PIO4	PIO3	PIO mode
0	0	Reserved
0	1	The ATA host shall use PIO mode 3 transfers.
1	0	The ATA host shall use PIO mode 4 transfers.
1	1	Reserved

underlying ATA host supports those transfer modes. The PIO3 bit shall be set to one if the ATA host supports PIO mode 3. The PIO3 bit and the PIO4 bit shall be set to one if the ATA host supports PIO mode 4.

If the SATL receives a MODE SELECT command and the PIO bits specify a change from the current setting, then the SATL shall configure the ATA host to use the new PIO transfer rate, if supported. If the application client

requests a PIO setting that the ATA device does not support, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The MWD0 bit, the MWD1 bit, and the MWD2 bit are collectively referred to as the MWDMA bits. If the ATA host in the SATL is currently configured to use multiword DMA (MWDMA), then the MWDMA bits are used to determine what mode is currently being used, what modes are supported by the ATA host, and control of the MWDMA mode.

If the SATL receives a MODE SENSE command requesting the current values of the PATA Control mode page, then the MWD0 bit shall be set to one by the SATL if the host and device are configured to use MWDMA mode 0. The MWD1 bit shall be set to one by the SATL if the host and device are configured to use MWDMA mode1. The MWD2 bit shall be set to one by the SATL if the host and device are configured to use MWDMA mode 2.

If the SATL receives a MODE SENSE command requesting the changeable values of the PATA Control mode page, then the MWD0 bit shall be set to one if the ATA host supports MWDMA mode 0. The MWD1 bit and MWD0 bit shall each be set to one if the ATA host supports MWDMA mode 1. The MWD2 bit, the MWD1 bit, and the MWD0 bit shall be each be set to one if the ATA host supports MWDMA mode 2.

Table 178 specifies values set by the SATL in the MWD0 bit, the MWD1 bit, and the MWD2 bit for current and changeable MWDMA settings.

Table 178 — MWDMA modes reported by MODE SENSE

MWDMA [a] bits			ATA host and device shared configuration settings returned as current values	ATA host support returned as changeable values
MWD 2	MWD 1	MWD 0		
0	0	0	Configured not to use multiword DMA	Illegal combination
1	0	0	Configured to use MWDMA mode 1	
0	1	0	Configured to use MWDMA mode 2	
1	1	0	Configured to use MWDMA modes 1 and 2	
0	0	1	Configured to use MWDMA mode 0	MWDMA mode 0 supported
1	0	1	Configured to use MWDMA modes 0 and 2	Illegal combination
0	1	1	Configured to use MWDMA modes 0 and 1	MWDMA mode 1 supported
1	1	1	Configured to use MWDMA modes 0, 1 and 2	MWDMA mode 2 supported

[a] If the application client attempts to set a MWDMA mode that is not supported by the ATA host environment, then the SATL shall return a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the SATL receives a MODE SELECT command and the MWDMA bits specify a change from the current settings, then the SATL shall send an ATA SET FEATURES - Set transfer mode (i.e., FEATURE field set to 03h) command to the ATA device to set the MWDMA mode on the ATA device to the requested state, and then:

a) if the ATA SET FEATURES command completes with an error, then the SATL shall:
   1) not change any host transfer modes; and
   2) complete the MODE SELECT command with a CHECK CONDITION status with the sense key set to ABORTED COMMAND with the additional sense code set to ATA DEVICE FAILED SET FEATURES;

   or

b) if the ATA SET FEATURES command completes without error, then the SATL shall:
   1) configure the ATA host to communicate with the device at the requested MWDMA transfer rate; and
   2) complete the MODE SELECT command with GOOD status.

The MWDMA bits values used to configure ATA hosts and ATA devices using the MODE SELECT command have the same meaning as the MWDMA bits values returned by the MODE SENSE command if current values are requested as shown in table 178.

If the SATL receives a request to set a MWDMA mode that is not supported by the ATA host or the attached PATA device, then the SATL shall return a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The UDMA0 bit, the UDMA1 bit, the UDMA2 bit, the UDMA3 bit, the UDMA4 bit, the UDMA5 bit, and the UDMA6 bit are collectively referred to as the UDMA bits, and are used to determine support for, current use of, and control of Ultra DMA (UDMA) transfer rates on the ATA host and device. The SATL shall determine the highest UDMA mode supported as being the lower of the ATA host maximum transfer mode and the device maximum transfer mode.

NOTE 12 - The ATA device returns the UDMA transfer mode specified in ATA IDENTIFY DEVICE data word 88 bits 6:0 (see ACS-3).

If the SATL receives a MODE SENSE command requesting the changeable values of the PATA Control mode page, then the UDMA bits shall be set according to table 179.

Table 179 — UDMA bits requirements for changeable MODE SENSE parameters

UDMA6	UDMA5	UDMA4	UDMA3	UDMA2	UDMA1	UDMA0	Highest UDMA mode supported
0	0	0	0	0	0	0	UDMA Unsupported
0	0	0	0	0	0	1	0
0	0	0	0	0	1	1	1
0	0	0	0	1	1	1	2
0	0	0	1	1	1	1	3
0	0	1	1	1	1	1	4
0	1	1	1	1	1	1	5
1	1	1	1	1	1	1	6

If the SATL receives a MODE SENSE command requesting the current values of the PATA Control mode page, then the SATL shall set the UDMA bits as defined in table 180. Only one of the UDMA bits shall be set to one at

any time for such a request. If UDMA is not the current DMA transfer mode, then all the UDMA bits shall be set to zero. If a UDMA transfer mode is being used, then all of the MWDMA bits shall be set to zero.

Table 180 — UDMA for current MODE SENSE settings

UDMA bit	Value	Description
UDMA0	0	ATA host and device are not communicating using UDMA Mode 0
	1	ATA host and device are communicating using UDMA Mode 0
UDMA1	0	ATA host and device are not communicating using UDMA Mode 1
	1	ATA host and device are communicating using UDMA Mode 1
UDMA2	0	ATA host and device are not communicating using UDMA Mode 2
	1	ATA host and device are communicating using UDMA Mode 2
UDMA3	0	ATA host and device are not communicating using UDMA Mode 3
	1	ATA host and device are communicating using UDMA Mode 3
UDMA4	0	ATA host and device are not communicating using UDMA Mode 4
	1	ATA host and device are communicating using UDMA Mode 4
UDMA5	0	ATA host and device are not communicating using UDMA Mode 5
	1	ATA host and device are communicating using UDMA Mode 5
UDMA6	0	ATA host and device are not communicating using UDMA Mode 6
	1	ATA host and device are communicating using UDMA Mode 6

If the SATL receives a MODE SELECT command and the UDMA bits request a change in the UDMA transfer rate, then the SATL shall:

1) if the SET FEATURES command completes with an error, then the SATL shall:
   A) not change any host transfer modes; and
   B) complete the MODE SELECT command with a CHECK CONDITION status with the sense key set to ABORTED COMMAND with the additional sense code set to ATA DEVICE FAILED SET FEATURES;

   or

2) if the SET FEATURES command completes without error, then the SATL shall:
   A) configure the ATA host to communicate with the device at the requested UDMA transfer rate; and
   B) complete the MODE SELECT command with GOOD status.

If the application client attempts to set a mode that the ATA host or the ATA device does not support, then the SATL shall terminate the MODE SELECT command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.

12.3.3 ATA Power Condition mode page

The ATA Power Condition mode page provides ATA specific controls for a SATL to configure ATA specific power management functions.

Table 181 shows the ATA Power Condition mode page.

Table 181 — ATA Power Condition mode page

Byte\Bit	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (1Ah)					
1	SUBPAGE CODE (F1h)							
2	(MSB)	PAGE LENGTH (000Ch)						
3								(LSB)
4	Reserved							
5	Reserved							APMP
6	APM VALUE							
7	Reserved							
15								

During the processing of a MODE SELECT command, if the APMP bit is set to zero, then the SATL shall ignore the APM VALUE field.

During the processing of a MODE SELECT command, if the APMP bit is set to one, then the SATL shall alter the ATA APM mode by issuing an ATA SET FEATURES command. If the APM VALUE field contains a non-zero value, then the ATA SET FEATURES – Enable/disable the APM feature set (i.e., subcommand 05h) command shall be sent and the APM VALUE field shall be used to set the power management level (i.e., COUNT field). If the APM VALUE field contains a zero, then the ATA SET FEATURES – Disable the APM feature set (i.e., subcommand 85h) command shall be sent.

If the ATA SET FEATURES command completes with an error, then the SATL shall terminate the MODE SELECT command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.

During the processing of a MODE SENSE command, the SATL shall determine if ATA APM mode is enabled by verifying that ATA IDENTIFY DEVICE data word 83, bit 3 is set to one, and that ATA IDENTIFY DEVICE data word 86, bit 3 is also set to one. If ATA APM mode is not enabled, then the APMP bit shall be set to zero. If ATA APM mode is enabled, then the APMP bit shall be set to one and the APM VALUE field shall contain the value from ATA IDENTIFY DEVICE word 91 bits (7:0).

12.4 SAT-specific VPD pages

12.4.1 SAT-specific VPD pages overview

This subclause describes VPD pages that the SATL may implement that are unique to the SCSI / ATA Translation standard. These VPD pages are for use by the SATL, are shown in table 182, and are described in this subclause.

Table 182 — SAT-Specific VPD pages

Page name	Page code	Type	Reference
ATA Information VPD page	89h	M	12.4.2

12.4.2 ATA Information VPD page

12.4.2.1 ATA Information VPD page overview

The ATA Information VPD page contains:

c) Information about the SATL;
d) Signature of the ATA or ATAPI device; and
e) ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data from the ATA or ATAPI device.

Some SATLs may modify ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data. If a SCSI application client requires the unmodified ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data, then the ATA PASS-THROUGH command (see 12.2) should be used to retrieve the unmodified ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data.

Table 183 defines the ATA Information VPD page.

Table 183 — ATA Information VPD page

Byte\Bit	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (89h)							
2	(MSB)			PAGE LENGTH (0238h)				
3								(LSB)
4				Reserved				
7								
8				SAT VENDOR IDENTIFICATION				
15								
16				SAT PRODUCT IDENTIFICATION				
31								
32				SAT PRODUCT REVISION LEVEL				
35								
36				Device signature (see 12.4.2.2)				
55								
56	COMMAND CODE							
57				Reserved				
59								
60				ATA IDENTIFY DEVICE DATA OR ATA IDENTIFY PACKET DEVICE DATA (see 12.4.2.3)				
571								

The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field shall be set as described in 8.1.2.

The SAT VENDOR IDENTIFICATION field shall contain an 8-byte ASCII string identifying the vendor of the SATL. The data shall be left aligned within the field. The vendor identification string shall be one assigned by INCITS for use in the Standard INQUIRY data VENDOR IDENTIFICATION field. A list of assigned vendor identification strings is in SPC-4 and on the T10 web site (http://www.t10.org).

The SAT PRODUCT IDENTIFICATION field shall contain sixteen bytes of ASCII data as defined by the vendor of the SATL. The data shall be left-aligned within the field.

The SAT PRODUCT REVISION LEVEL field shall contain four bytes of ASCII data as defined by the vendor of the SATL. The data shall be left-aligned within the field.

The ATA device signature is described in 12.4.2.2.

The COMMAND CODE field contains the of the ATA command code used to retrieve the data in the ATA IDENTIFY DEVICE or ATA IDENTIFY PACKET DEVICE data . The possible command codes are:

a) ECh for an ATA IDENTIFY DEVICE command (i.e., for an ATA device);
b) A1h for an ATA IDENTIFY PACKET DEVICE command (i.e., for an ATAPI device); or
c) 00h for other device types.

The ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data is described in 12.4.2.3.

12.4.2.2 ATA device signature

The ATA device signature shall contain the contents of the task file fields after the last power-on reset, hardware reset, software reset, or ATA EXECUTE DEVICE DIAGNOSTIC command. The ATA device signature shall follow the format of the initial SATA Register Device to Host FIS (see SATA-3.1). Table 184 shows the ATA device signature.

Table 184 — ATA device signature

Byte\Bit	7	6	5	4	3	2	1	0
0	TRANSPORT IDENTIFIER							
1	Reserved	INTERRUPT/ Reserved [a]	Reserved		PM PORT / Reserved [a]			
2	STATUS [b]							
3	ERROR [b]							
4	LBA (7:0) [b]							
5	LBA (15:8) [b]							
6	LBA (23:16) [b]							
7	DEVICE [b]							
8	LBA (31:24) [b]							
9	LBA (39:32) [b]							
10	LBA (47:40) [b]							
11	Reserved							
12	COUNT (7:0) [b]							
13	COUNT (15:8) [b]							
14	Reserved							
19								

[a] The INTERRUPT bit and the PM PORT field are defined only if the TRANSPORT IDENTIFIER field is set to 34h (see SATA-3.1). Otherwise the INTERRUPT field and the PM PORT field are reserved.

[b] These fields are fields with the same names defined in ACS-3.

The TRANSPORT IDENTIFIER field is defined in table 185.

Table 185 — TRANSPORT IDENTIFIER field

Code	Transport
00h	PATA (see ATA8-APT)
34h	SATA (see SATA-3.1)
All others	Reserved

The INTERRUPT bit corresponds to the “I” bit (i.e., dword 0 bit 14) of the Register Device to Host FIS (see SATA-3.1).

All the remaining fields within the ATA device signature are defined in ATA8-APT and SATA-3.1.

12.4.2.3 ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data

If the command is an ATA IDENTIFY DEVICE command and the command completes without error, then the ATA IDENTIFY DEVICE OR ATA IDENTIFY PACKET DEVICE DATA field shall contain the ATA IDENTIFY DEVICE data (ACS-3).

If the command is an ATA IDENTIFY PACKET DEVICE command, and the command completes without error, then the ATA IDENTIFY DEVICE OR ATA IDENTIFY PACKET DEVICE DATA field shall contain the IDENTIFY PACKET DEVICE data (see ACS-3).

The ATA IDENTIFY DEVICE OR ATA IDENTIFY PACKET DEVICE DATA field shall contains 512 bytes of 00h if:

d) the command is an ATA IDENTIFY DEVICE command or an ATA IDENTIFY PACKET DEVICE command and the command completes with an error; or
e) the command code is 00h (i.e., some other device type).

The data shall be presented with byte preservation (i.e., ATA byte n maps to SCSI byte n), as shown in table 186.

Table 186 — ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data

Byte	Contents
0	ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data word 0 bits 7:0 (i.e., byte 0)
1	ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data word 0 bits 15:8 (i.e., byte 1)
2	ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data word 1 bits 7:0 (i.e., byte 2)
3	ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data word 1 bits 15:8 (i.e., byte 3)
...	...
510	ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data word 255 bits 7:0 (i.e., the signature byte of the Integrity word, see ACS-3)
511	ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data word 255 bits 15:8 (i.e., the checksum byte of the Integrity word, see ACS-3)

NOTE 13 - Although the Serial number field (i.e., words 10 to 19), Firmware revision field (i.e., words 23 to 26), and Model number field (i.e., words 27 to 46) contain ASCII characters, every other byte is swapped within them (see ATA8-ACS) (e.g., the Serial number field is interpreted as: {word 10 bits 15:8, word 10 bits 7:0, word 11 bits 15:8, word 11 bits 7:0,...}, which corresponds to these bytes in the IDENTIFY DEVICE OR IDENTIFY PACKET DEVICE DATA field: {byte 21, byte 20, byte 23, byte 22, etc.}).

Since some of the fields within the ATA IDENTIFY DEVICE data or ATA IDENTIFY PACKET DEVICE data may change depending on the state of the ATA device, the SATL shall resend the ATA IDENTIFY DEVICE command or ATA IDENTIFY PACKET DEVICE command to retrieve updated data whenever the ATA Information VPD page is requested.

12.5 SAT-specific security protocols

12.5.1 ATA Device Server Password security protocol

12.5.1.1 SECURITY PROTOCOL IN command

12.5.1.1.1 SECURITY PROTOCOL IN command overview

The SECURITY PROTOCOL IN command is used by the application client to cause the SATL to return ATA Security feature set data extracted from the ATA IDENTIFY DEVICE data from the ATA device. See ACS-3 for a description of the ATA Security feature set.

If the SECURITY PROTOCOL field is set to EFh in a SECURITY PROTOCOL IN command, then the SECURITY PROTOCOL SPECIFIC field shall be set to zero. All other values of the SECURITY PROTOCOL SPECIFIC field are reserved.

The INC_512 bit shall be set to zero. If a SECURITY PROTOCOL IN command is received with the INC_512 bit is set to one, then the SECURITY PROTOCOL IN command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

All other CDB fields for SECURITY PROTOCOL IN command shall meet the requirements stated in SPC-4.

12.5.1.1.2 SECURITY PROTOCOL IN parameter data

Table 187 defines the parameter data sent in response to a SECURITY PROTOCOL IN command with the SECURITY PROTOCOL field set to EFh.

Table 187 — SECURITY PROTOCOL IN parameter data

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	PARAMETER LIST LENGTH (0Eh)							
2	(MSB)	SECURITY ERASE TIME						
3								(LSB)
4	(MSB)	ENHANCED SECURITY ERASE TIME						
5								(LSB)
6	(MSB)	MASTER PASSWORD IDENTIFIER						
7								(LSB)
8	Reserved							MAXSET
9	Reserved		EN_ER_SUP	PWCNTEX	FROZEN	LOCKED	S_ENABLD	S_SUPRT
10	Reserved							
15								

The value in the SECURITY ERASE TIME field indicates the time required by the ATA device to complete its security erase procedure in normal mode. The SATL shall set bits(7:0) of the SECURITY ERASE TIME field to the ATA IDENTIFY DEVICE data word 89 bits (7:0) and bits (15:8) of the SECURITY ERASE TIME field to 00h.

The value in the ENHANCED SECURITY ERASE TIME field indicates the time required by the ATA device to complete its security erase procedure in enhanced mode. The SATL shall set bits(7:0) of the ENHANCED SECURITY ERASE TIME field to the ATA IDENTIFY DEVICE data word 90 bits (7:0) and the bits(15:8) of the ENHANCED SECURITY ERASE TIME field to 00h.

The SATL shall set the MASTER PASSWORD IDENTIFIER field to the ATA IDENTIFY DEVICE data word 92.

If the ATA IDENTIFY DEVICE data word 128 bit 8 is set to zero, then the SATL shall set the master password capability setting (MAXSET) bit to zero. If the ATA IDENTIFY DEVICE data word 128 bit 8 is set to one, then the SATL shall set the MAXSET bit to one.

If the ATA IDENTIFY DEVICE data word 128 bit 5 is set to zero, then the SATL shall set the enhanced erase mode supported (EN_ER_SUP) bit to zero. If the ATA IDENTIFY DEVICE data word 128 bit 5 is set to one, then the SATL shall set the EN_ER_SUP bit to one.

If the ATA IDENTIFY DEVICE data word 128 bit 4 is set to zero, then the SATL shall set the password attempt counter exceeded (PWCNTEX) bit to zero. If the ATA IDENTIFY DEVICE data word 128 bit 4 is set to one, then the SATL shall set the PWCNTEX bit to one.

If the ATA IDENTIFY DEVICE data word 128 bit 3 is set to zero, then the SATL shall set the frozen state (FROZEN) bit to zero. If the ATA IDENTIFY DEVICE data word 128 bit 3 is set to one, then the SATL shall set the FROZEN bit to one.

If the ATA IDENTIFY DEVICE data word 128 bit 2 is set to zero, then the SATL shall set the locked state (LOCKED) bit to zero. If the ATA IDENTIFY DEVICE data word 128 bit 2 is set to one, then the SATL shall set the LOCKED bit to one.

If the ATA IDENTIFY DEVICE data word 85 bit 1 is set to zero, then the SATL shall set the ATA Security feature set enabled (S_ENABLD) bit to zero. If the ATA IDENTIFY DEVICE data word 85 bit 1 is set to one, then the SATL

shall set the S_ENABLD bit to one. Enabling of this bit is based on setting of the user password via a set password function (see 12.5.1.2.1).

If the ATA IDENTIFY DEVICE data word 82 bit 1 is set to zero, then the SATL shall set the ATA Security feature set supported (S_SUPRT) bit to zero. If the ATA IDENTIFY DEVICE data word 82 bit 1 is set to one, then the SATL shall set the S_SUPRT bit to one.

12.5.1.1.3 SCSI commands allowed in the presence of various security modes

Certain commands may be allowed or conflict depending on the security mode setting that is in effect for an ATA device.

There are three possible modes:

a) security locked;
b) security unlocked or security disabled; and
c) security frozen.

If a SATL receives a command that is allowed for the current security mode setting of the ATA device, then the SATL translates the command as defined in this standard and sends it to the ATA device. If a SATL receives a command that conflicts with the current security mode setting of the ATA device, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to SECURITY CONFLICT IN TRANSLATED DEVICE.

Table 188 shows the commands defined in SPC-4 and whether each command is allowed or conflicts depending on the security setting that is in effect for an ATA device. If a command in table 188 is not implemented by the

SATL, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to

ILLEGAL REQUEST and the additional sense code set to INVALID COMMAND OPERATION CODE.

Table 188 — SPC commands allowed in the presence of various ATA security modes (part 1 of 3)

Command	Locked	Unlocked or Disabled	Frozen
ACCESS CONTROL IN [a]	Allowed	Allowed	Allowed
ACCESS CONTROL OUT [a]	Allowed	Allowed	Allowed
CHANGE ALIASES [a]	Allowed	Allowed	Allowed
COPY OPERATION ABORT	Conflict		
EXTENDED COPY(LID4) [a]	Conflict	Allowed	Allowed
EXTENDED COPY(LID1)	Conflict		
INQUIRY	Allowed	Allowed	Allowed
LOG SELECT	Allowed [b]	Allowed	Allowed
LOG SENSE [a]	Allowed	Allowed	Allowed
MANAGEMENT PROTOCOL IN [a]	Allowed	Allowed	Allowed
MANAGEMENT PROTOCOL OUT [a]	Allowed	Allowed	Allowed
MODE SELECT(6) / MODE SELECT(10)			
All mode pages	Allowed	Allowed	Allowed
MODE SENSE(6) / MODE SENSE(10)	Allowed	Allowed	Allowed
PERSISTENT RESERVE IN [a]	Allowed	Allowed	Allowed
PERSISTENT RESERVE OUT			
REGISTER [a]	Allowed	Allowed	Allowed
RESERVE [a]	Allowed	Allowed	Allowed
RELEASE [a]	Allowed	Allowed	Allowed
CLEAR [a]	Allowed	Allowed	Allowed
PREEMPT [a]	Allowed	Allowed	Allowed
PREEMPT AND ABORT [a]	Allowed	Allowed	Allowed
REGISTER AND IGNORE EXISTING KEY [a]	Allowed	Allowed	Allowed
REGISTER AND MOVE [a]	Allowed	Allowed	Allowed
READ ATTRIBUTE [a]	Allowed	Allowed	Allowed
READ BUFFER	Allowed	Allowed	Allowed
READ MEDIA SERIAL NUMBER [a]	Allowed	Allowed	Allowed
RECEIVE COPY DATA(LID4)	Allowed	Allowed	Allowed
RECEIVE COPY DATA(LID1)	Conflict	Allowed	Allowed
RECEIVE COPY OPERATING PARAMETERS	Conflict	Allowed	Allowed

[a] SECURITY CONFLICT IN TRANSLATED DEVICE shall not be returned for this command.
[b] Allowed unless otherwise specified.

Table 188 — SPC commands allowed in the presence of various ATA security modes (part 2 of 3)

Command	Locked	Unlocked or Disabled	Frozen
RECEIVE COPY FAILURE DETAILS(LID1)	Conflict	Allowed	Allowed
RECEIVE COPY STATUS(LID4) [a]	Allowed	Allowed	Allowed
RECEIVE COPY STATUS(LID1)	Conflict	Allowed	Allowed
RECEIVE ROD TOKEN INFORMATION	Allowed	Allowed	Allowed
RECEIVE CREDENTIALS	Allowed	Allowed	Allowed
RECEIVE DIAGNOSTIC RESULTS [a]	Allowed	Allowed	Allowed
REPORT ALIASES [a]	Allowed	Allowed	Allowed
REPORT ALL ROD TOKENS	Allowed	Allowed	Allowed
REPORT IDENTIFYING INFORMATION [a]	Allowed	Allowed	Allowed
REPORT LUNS [a]	Allowed	Allowed	Allowed
REPORT PRIORITY [a]	Allowed	Allowed	Allowed
REPORT SUPPORTED OPERATION CODES [a]	Allowed	Allowed	Allowed
REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS [a]	Allowed	Allowed	Allowed
REPORT TARGET PORT GROUPS [a]	Allowed	Allowed	Allowed
REPORT TIMESTAMP [a]	Allowed	Allowed	Allowed
REQUEST SENSE	Allowed	Allowed	Allowed
SECURITY PROTOCOL IN [a]	Allowed	Allowed	Allowed
SECURITY PROTOCOL OUT			
Tape Data Encryption [a]	Conflict	Conflict	Conflict
Authentication in Host Attachments of Transient Storage Devices [a]	Conflict	Conflict	Conflict
Device Server Password Security	Allowed	Allowed	Conflict
IEEE 1667 [a]	Conflict	Conflict	Conflict
TCG [a]	Conflict	Conflict	Conflict
SEND DIAGNOSTIC	Allowed	Allowed	Allowed
SET IDENTIFYING INFORMATION [a]	Allowed	Allowed	Allowed
SET PRIORITY [a]	Allowed	Allowed	Allowed
SET TARGET PORT GROUPS [a]	Allowed	Allowed	Allowed
SET TIMESTAMP [a]	Allowed	Allowed	Allowed

[a] SECURITY CONFLICT IN TRANSLATED DEVICE shall not be returned for this command.
[b] Allowed unless otherwise specified.

Table 188 — SPC commands allowed in the presence of various ATA security modes (part 3 of 3)

Command	Locked	Unlocked or Disabled	Frozen
TEST UNIT READY	Allowed	Allowed	Allowed
WRITE ATTRIBUTE [a]	Allowed	Allowed	Allowed
WRITE BUFFER	Allowed	Allowed	Allowed

[a] SECURITY CONFLICT IN TRANSLATED DEVICE shall not be returned for this command.
[b] Allowed unless otherwise specified.

Table 189 shows the commands defined in SBC-3 and whether each command is allowed or conflicts depending on the security setting that is in effect for an ATA device. If a command in table 189 is not implemented by the

SATL, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID COMMAND OPERATION CODE.

Table 189 — SBC commands allowed in the presence of various ATA security modes

Command	Locked	Unlocked or Disabled	Frozen
COMPARE AND WRITE	Conflict	Allowed	Allowed
FORMAT UNIT	Conflict	Allowed	Allowed
GET LBA STATUS	Allowed	Allowed	Allowed
ORWRITE [a]	Conflict	Allowed	Allowed
PRE-FETCH (10) / (16) [a]	Conflict	Allowed	Allowed
PREVENT ALLOW MEDIUM REMOVAL (Prevent=0) [a]	Conflict	Allowed	Allowed
PREVENT ALLOW MEDIUM REMOVAL (Prevent<>0) [a]	Conflict	Allowed	Allowed
READ (10) / (12) / (16) / (32)	Conflict	Allowed	Allowed
READ CAPACITY (10) / (16)	Allowed	Allowed	Allowed
READ DEFECT DATA (10) / (12) [a]	Conflict	Allowed	Allowed
READ LONG (10) / (16) [a]	Conflict	Allowed	Allowed
REASSIGN BLOCKS	Conflict	Allowed	Allowed
START STOP UNIT	Allowed	Allowed	Allowed
SYNCHRONIZE CACHE (10) / (16)	Conflict	Allowed	Allowed
UNMAP	Conflict	Allowed	Allowed
VERIFY (10) / (12) / (16) / (32)	Conflict	Allowed	Allowed
WRITE (10) / (12) / (16) / (32)	Conflict	Allowed	Allowed
WRITE AND VERIFY (10) / (12) / (16) / (32)	Conflict	Allowed	Allowed
WRITE LONG (10) / (16) [a]	Conflict	Allowed	Allowed
WRITE SAME (10) / (16) / (32)	Conflict	Allowed	Allowed
XDWRITEREAD (10) / (32)	Conflict	Allowed	Allowed
XPWRITE (10) / (32)	Conflict	Allowed	Allowed

[a] ATA SECURITY CONFLICT shall not be returned for this command.

Table 190 shows the commands defined in this specification and whether each command is allowed or conflicts depending on the security setting that is in effect for an ATA device. If a command in table 190 is not implemented by the SATL, then the SATL shall terminate the command with CHECK CONDITION status with the

sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID COMMAND OPERATION CODE.

Table 190 — SAT-specific commands allowed in the presence of various ATA security modes

Command	Locked	Unlocked or Disabled	Frozen
ATA PASS-THROUGH (12)	Allowed	Allowed	Allowed
ATA PASS-THROUGH (16)	Allowed	Allowed	Allowed

12.5.1.2 SECURITY PROTOCOL OUT command

12.5.1.2.1 SECURITY PROTOCOL OUT command overview

The SECURITY PROTOCOL OUT command is used by an application client to send ATA Security feature set commands and data to the ATA device. See ACS-3 for a description of the ATA Security feature set and all of the functions defined in this standard.

If the SECURITY PROTOCOL field is set to EFh in a SECURITY PROTOCOL OUT command, the SECURITY PROTOCOL SPECIFIC field specifies the ATA command that the SATL shall send to the ATA device(see table 191).

Table 191 — SECURITY PROTOCOL SPECIFIC field

SECURITY PROTOCOL SPECIFIC field	Description	ATA command processing reference	Parameter data reference
0000h	Reserved		
0001h	Set password	ATA SECURITY SET PASSWORD	12.5.1.2.2
0002h	Unlock	ATA SECURITY UNLOCK	12.5.1.2.3
0003h	Erase prepare	ATA SECURITY ERASE PREPARE	No data is transferred
0004h	Erase unit	ATA SECURITY ERASE UNIT	12.5.1.2.4
0005h	Freeze lock	ATA SECURITY FREEZE LOCK	No data is transferred
0006h	Disable password	ATA SECURITY DISABLE PASSWORD	12.5.1.2.5
0007h through FFFFh	Reserved		

The INC_512 bit shall be set to zero. If a SECURITY PROTOCOL OUT command is received with the INC_512 bit is set to one, then the SECURITY PROTOCOL OUT command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

All other CDB fields for the SECURITY PROTOCOL OUT command shall meet the requirements stated in SPC-4.

12.5.1.2.2 Set password parameter list

If the SECURITY PROTOCOL SPECIFIC field is set to 0001h in the SECURITY PROTOCOL OUT CDB, then the TRANSFER LENGTH field in the CDB shall be set to 24h. Table 192 defines the parameter list for the SECURITY PROTOCOL OUT command if the SECURITY PROTOCOL SPECIFIC field is set to 0001h (i.e., set password).

Table 192 — Set password parameter list

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved							MAXLVL
1	Reserved							MSTRPW
2	(MSB)							
33				PASSWORD				(LSB)
34	(MSB)							
35				MASTER PASSWORD IDENTIFIER				(LSB)

The MAXLVL bit specifies the value of word 0, bit 8 of the ATA SECURITY SET PASSWORD data.

The MSTRPW bit specifies the value of word 0, bit 0 of the ATA SECURITY SET PASSWORD data.

If the MSTRPW field is set to one, the ATA SECURITY SET PASSWORD data word 17 is set to the value of the MASTER PASSWORD IDENTIFIER field.

The SATL shall set the ATA SECURITY SET PASSWORD PASSWORD data words (1:16) to the value of the PASSWORD field.

12.5.1.2.3 Unlock parameter list

If the SECURITY PROTOCOL SPECIFIC field is set to 0002h in the SECURITY PROTOCOL OUT CDB, then the TRANSFER LENGTH field in the CDB shall be set to 24h. Table 193 defines the parameter list for the SECURITY PROTOCOL OUT command if the SECURITY PROTOCOL SPECIFIC field is set to 0002h (i.e., unlock).

Table 193 — Unlock parameter list

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved							
1	Reserved							MSTRPW
2	(MSB)							
33				PASSWORD				(LSB)
34								
35				Reserved				

The SATL shall copy the MSTRPW bit to ATA SECURITY UNLOCK data word 0 bit 0.

The SATL shall copy the PASSWORD field to ATA SECURITY UNLOCK data words 1 to 16.

12.5.1.2.4 Erase unit parameter list

If the SECURITY PROTOCOL SPECIFIC field is set to 0004h in the SECURITY PROTOCOL OUT CDB, then the TRANSFER LENGTH field in the CDB shall be set to 24h. Table 194 defines the parameter list for the SECURITY PROTOCOL OUT command if the SECURITY PROTOCOL SPECIFIC field is set to 0004h (i.e., erase unit).

Table 194 — Erase unit parameter list

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved							EN_ER
1	Reserved							MSTRPW
2	(MSB)							
33				PASSWORD				(LSB)
34								
35				Reserved				

The SATL shall copy the EN_ER bit to ATA SECURITY ERASE UNIT data word 0, bit 1.

The SATL shall copy the MSTRPW bit to ATA SECURITY ERASE UNIT data word 0, bit 0.

The SATL shall copy the PASSWORD field to ATA SECURITY ERASE UNIT data words 1 to 16.

12.5.1.2.5 Disable password parameter list

If the SECURITY PROTOCOL SPECIFIC field is set to 0006h in the SECURITY PROTOCOL OUT CDB, then the TRANSFER LENGTH field in the CDB shall be set to 24h. Table 195 defines the parameter list for the SECURITY PROTOCOL OUT command if the SECURITY PROTOCOL SPECIFIC field is set to 0006h (i.e., disable password).

Table 195 — Disable password parameter list

Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved							
1	Reserved							MSTRPW
2	(MSB)							
33				PASSWORD				(LSB)
34								
35				Reserved				

The SATL shall copy the MSTRPW bit to ATA SECURITY DISABLE PASSWORD data word 0, bit 0.

The SATL shall copy the PASSWORD field to the ATA SECURITY DISABLE PASSWORD data words 1 to 16.

12.6 SAT-specific log pages

12.6.1 SAT-specific log pages overview

This subclause describes log pages that the SATL may implement that are unique to the SCSI / ATA Translation standard. These log pages are for use by the SATL, are shown in table 196, and are described in this subclause.

Table 196 — SCSI / ATA Translation specific log pages

PAGE CODE	SUBPAGE CODE	Log page name	Reference
16h	00h	ATA PASS-THROUGH Results log page	12.6.2

12.6.2 ATA PASS-THROUGH Results log page

The ATA PASS-THROUGH Results log page reports descriptor format sense data for ATA PASS-THROUGH commands that were terminated with CHECK CONDITION status by a device server that returned fixed format sense data and was not able to return the complete set of information (see 12.2.2.6).

This log page uses the binary list parameter format defined in SPC-4.

The number of log parameters reported shall be less than or equal to 15.

The PARAMETER CODE field of each log parameter indicates the value of the LOG INDEX field minus one returned in fixed format sense data (e.g., parameter code 0h corresponds to log index 1h, and parameter code Eh corresponds to log index Fh) (see 12.2.2.6). The device server shall support log parameter codes 0h through Eh.

The FORMAT AND LINKING field of each log parameter shall be set to 11b, indicating that the parameters are binary format list parameters. The values of the bits and fields in the parameter control byte for binary format list parameters are described in SPC-4.

The PARAMETER LENGTH field of each log parameter is defined in SPC-4.

The PARAMETER VALUE field of each log parameter indicates the descriptor format sense data.

Annex A
(normative)

SCSI to ATAPI command transmission

A.1 Introduction

This annex specifies the method of transmission of SCSI commands t15 September, 2015o an ATAPI device.

A.2 ATAPI device model

An ATAPI device operates by using the ATA PACKET command, in order to transmit a SCSI CDB to the device. In addition to the SCSI command set supported by the device, the ATAPI device also supports a limited subset of the ATA command set to facilitate the identification and control of the device. The device supports its primary function (e.g., read or write operations) through a SCSI command set that the device supports. An ATAPI device may implement any command set reportable through the SCSI standard INQUIRY data PERIPHERAL DEVICE TYPE field.

To detect whether an attached device is an ATA device or an ATAPI device, the SATL may issue an ATA IDENTIFY DEVICE command. If the device is an ATAPI device, the device aborts the ATA IDENTIFY DEVICE command and returns a specific signature.

A.3 SCSI CDB transmission

A SCSI CDB is transmitted by a SATL to an ATAPI device by the following sequence:

1) issuing the PACKET command to the device;
1) transmitting the SCSI CDB to the device (the command packet phase); and
2) transmitting or receiving any data, if appropriate, necessary for the completion of the SCSI CDB.

Some ATAPI devices do not permit the Byte Count Limit parameter of the ATA PACKET command to be zero, even if the CDB requires no data transmission. This restriction, or the lack of such a restriction, is specified for each device in ATA IDENTIFY PACKET DEVICE data word 125 (see ACS-3). If the device places a restriction, then the SATL should place a value of 512 in the Byte Count Limit parameter of the ATA PACKET command when transmitted if the CDB being processed requires no data transfer to or from the device.

Within the ATA IDENTIFY PACKET DEVICE data returned by the device is a command size requirement for any SCSI CDB transmitted to the device through the packet command. This restriction is located in ATA IDENTIFY PACKET DEVICE data word 0, bits 1:0. This field specifies either a 12 byte or 16 byte CDB restriction. CDBs of a smaller size may be transmitted by the SATL to the device, however any additional bytes beyond the length of the CDB shall be transmitted as zero.

For example, if an ATAPI device reports that 12 byte command packets are required and the SATL sends an INQUIRY command to the device, the SATL would transmit the six bytes of the INQUIRY command, followed by six bytes set to zero.

If an application client sends a CDB to the SATL, where the size is greater than the maximum command packet size supported by the ATAPI device, then the SATL shall complete the command with CHECK CONDITION status and a sense key of ILLEGAL REQUEST and an additional sense code of INVALID COMMAND OPERATION CODE.

During data transfers, ATAPI devices transmit or receive data on word boundaries. If a SATL transmits a data buffer whose length is not a multiple of a word, then the SATL shall pad the transmitted data with an additional byte set to zero. During data reception, the SATL shall allocate its receive buffers to accommodate an additional byte if the data length is not a multiple of a word.

In addition to the word alignment requirements, ATAPI devices may have additional requirements imposed on them for padding based on the underlying transport (e.g., SATA ATAPI devices are required to transmit all data aligned to a dword. Therefore, a SATL in that environment allocates sufficient receive or transmit buffers to transmit or receive data that has been padded with zeros to a dword boundary).

If the ATAPI device completes a packet command with an error, then the SATL shall send a REQUEST SENSE command to the device through the command transmission mechanism described in this subclause to obtain sense data before completing the CDB to the application client as ATAPI devices do not support any form of autosense. In addition SATL error handling does not use the error translation specified in this standard.

ATAPI devices do not support any form of ATA queued command transmission and SATL implementations shall either maintain an internal queue of received commands for the device or return TASK SET FULL status to the application client if there is already an ATA PACKET command sequence in process or pending for the ATAPI device.

A.4 ATAPI Command management

The PACKET command protocol does not have a mechanism for transmission of task management functions to an ATAPI device. Translation of task management functions by a SATL is unspecified.

A.5 SATL ATAPI implementations

If a SATL supports attachment of ATAPI devices, then the SATL shall not use the translations described elsewhere in this standard for the generation of INQUIRY data and instead shall return the INQUIRY data directly from the ATAPI device. In addition, the SATL shall transmit all SCSI CDBs that are permissible within the command packet data length restrictions (see A.3). The SATL may generate results for the VPD pages 00h(i.e., Supported VPD pages VPD page) and 83h (i.e., Device Identification VPD page) and not send these requests to the ATA device.

A.6 ATAPI I_T nexus loss handling

For an I_T nexus loss event, the SATL shall:

1) issue a software reset to the ATAPI device; and
2) delete all commands in the task set from the SATL internal context.